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Horizontal Convective Condensation of Alternative Refrigerants within a Micro-Fin Tube

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ABSTRACT

This paper presents local convective condensation measurements for four refrigerants: R134a, R410A(R32/R125, 50/50 % mass), R125, and R32 in a micro-fin tube¹. Both heat transfer and pressure drop measurements are provided. The heat transfer degradation associated with R410A was shown to be relatively small and believed to be mostly due to nonlinear property effects. The measured convective condensation Nusselt numbers for all of the test refrigerants were correlated to a single expression consisting of a product of dimensionless properties. The correlation was shown to predict some existing data from the literature within acceptable limits. The correlation poorly predicted the heat transfer performance of cross-grooved, micro-fin tubes. The pressure drop measurements for the micro-fin tube were predicted satisfactorily by an existing correlation for flow boiling pressure drop in a smooth tube. Correlation of the pressure drop measurements suggested that the heat transfer enhancement was due to the fins behaving as a surface roughness.

Keywords: Enhanced heat transfer, micro-fin, refrigerant mixtures, fluid heating, condensation, pressure drop

¹In order to describe materials and experimental procedures adequately, it is occasionally necessary to identify commercial products by manufacturers' name or label. In no instance does such identification imply endorsement by the National Institute of Standards and Technology, nor does it imply that the particular product or equipment is necessarily the best available for the purpose.

NOMENCLATURE

English symbols

A_c	cross sectional flow area inside tube (m^2)
A_i	actual inner surface area of tube (m^2)
c_p	specific heat ($J/kg \cdot K$)
d	number of model parameters
D	tube diameter (m)
D_e	equivalent inner diameter of smooth tube, $\sqrt{\frac{4A_c}{\pi}}$ (m)
D_h	hydraulic diameter of micro-fin tube, (m)
E_h	heat-transfer enhancement ratio
f	Fanning friction factor
g	gravitational acceleration, 9.8 m/s^2
G	Mass velocity ($kg/m^2 \cdot s$)
$h_{2\phi}$	local two-phase heat-transfer coefficient ($W/m^2 \cdot K$)
h_L	h from linear fit between pure components ($W/m^2 \cdot K$)
i	enthalpy (J/kg)
i_{fg}	latent heat of vaporization (J/kg)
Ja	refrigerant Jacob Number $\frac{i_{fg}}{c_{p,r,1} \Delta T_s}$
k	refrigerant thermal conductivity ($W/m \cdot K$)
L	tube length (m)
Nu	local Nusselt number based on D_h
N_f	number of fins
\dot{m}	mass flow rate (kg/s)
M	molecular weight (g/mole)
n	number of data points
p	wetted perimeter of inner micro-fin tube (m)
P	local fluid pressure (Pa)
Pr	liquid refrigerant Prandtl number $\frac{c_p \mu}{k} \big _{r,1}$
q''	local heat flux (W/m^2)
Re	all liquid, refrigerant Reynolds number based on $D_h = \frac{GD_h}{\mu_{r,1}}$
S	perimeter of one fin and channel (m)
Sv	non-dimensional refrigerant specific volume $\frac{v_v - v_1}{v} \big _x$
T	temperature (K)
U	expanded relative uncertainty
x_q	thermodynamic mass quality
z	axial distance (m)

Greek symbols

α	helix angle between micro fin and tube axis
β	exponent on correlation
$\Delta h_{2\phi}$	heat transfer degradation ($W/m^2 \cdot K$)
ΔP	pressure drop (Pa)
ΔT_s	$T_s - T_w$ (K)

Φ	two-phase number, $\frac{\Delta x_{q\ i\ fg}}{\Delta L\ g}$
μ	dynamic viscosity (kg/m·s)
ν	specific volume, $x_q\nu_v + (1-x_q)\nu_l$ (m ³ /kg)

subscripts

b	bulk condition
c	critical condition
f	water
i	inlet, inner
l	liquid
o	outside
p	plain or smooth tube
r	refrigerant
s	saturated state
w	heat transfer surface
v	vapor

INTRODUCTION

Most evaporators and condensers of new unitary refrigeration and air-conditioning equipment are manufactured with micro fin tubes. The micro-fin tube dominates unitary equipment design because it provides the highest heat transfer with the lowest pressure drop of the commercially available internal enhancements (Webb, 1994). Together, R134a, R22, and R22 replacements constitute by mass nearly all the refrigerants used in unitary products (Muir, 1989). Consequently, two phase heat transfer data for the micro-fin tube with R134a, R22, and R22 replacements are essential for the design of evaporators and condensers for unitary applications.

Although the study of R134a, R22 and R22 replacements in micro-fin tubes is important, the work available in the open literature is limited. For example, there are surprisingly few studies on R22 replacements and micro-fin tubes. Wang et al. (1996) present quasi-local condensation heat transfer coefficients for R22 and R407C. Also, Kaul et al. (1996) present local flow boiling heat transfer measurements for R410B and R407C. Most of the available literature focuses on the heat transfer of R134a and R22. A survey by Schlager et al. (1990), which was later updated by Eckels et al. (1992), on all the refrigerant heat transfer with micro-fin tubes, showed that of the 22 studies, five were with R113, 15 were with R22, and two examined both fluids. The survey also revealed that condensation research has been neglected relative to evaporation research. For example, 17 of the surveyed studies did not investigate condensation. With help from the Bergles et al. (1995) survey and our own search, we were able to find only ten additional papers on convective condensation in micro-fin tubes. Four of these studies were for R134a, five were for R22, and one was the Wang et al. (1996) paper on R407C. Most of the recent R134a studies were of global heat transfer measurements as done by Eckels et al. (1994). However, only four studies - Chamra and Webb (1995), Chiang (1993), Mori and Nakayama (1983), and Khanpara et al. (1986) - that present local condensation measurements in a micro-fin tube were found.

Local condensation measurements will prove most useful to the refrigeration industry. An accurate sizing of a micro-fin tubed condenser requires an accurate local heat-transfer correlation. Unfortunately, neither Ghaderi et al. (1995) nor Webb (1994) were able to find a convective condensation correlation for the micro-fin tube in the literature. The absence of a universal condensation correlation may be partly due to the many variants of the micro-fin geometry and the common practice of using the root diameter area instead of the actual surface area and the hydraulic diameter to calculate the heat transfer. A single local heat transfer correlation that can be used for different micro-fin geometries would be useful to the refrigeration industry.

Considering the shortage of convective condensation data for R22 replacements in a micro-fin tube and the absence of a heat transfer correlation, there were two main objectives of the study. The first was to characterize the convective condensation performance of two R22 alternatives in a micro-fin tube. Specifically, the local convective condensation pressure drop and heat transfer coefficient of R134a and the near-azeotropic refrigerant mixture R410A along with its pure components R32 and R125 were experimentally determined. The experimental measurements for the fluids were correlated to a single correlation as a function of non-dimensional parameters. The second objective was to fundamentally characterize the heat transfer degradation of R410A relative to the performance of the pure components. Convective condensation heat transfer coefficients for the mixtures' pure components were measured to establish a baseline for the heat transfer degradation calculations. A fundamental understanding of mixture heat transfer mechanisms can be used to refine the selection of mixture composition and/or mixtures for alternative refrigerants.

EXPERIMENTAL APPARATUS

Figure 1 shows a sketch of the experimental apparatus used to establish and measure the convective condensation. The refrigerant flow rate, pressure, and superheat were fixed at the inlet to the test section. The water flow rate and the inlet temperature were fixed to establish the overall refrigerant quality change in the test section. The water temperature drop, the tube wall temperature, the refrigerant

temperatures, pressures, and pressure drops were measured at several axial locations along the test section. These measurements were used to calculate the local heat-transfer coefficient for the micro-fin tube.

The test section consisted of a pair of 3.34 m long, horizontal tubes connected by a U-bend. A fixed test pressure was maintained by balancing the refrigerant duty between the subcooler, the test section, and the evaporator. A magnetically coupled gear pump delivered the test refrigerant to the entrance of the test section with a few degrees of vapor superheat. Another magnetically coupled gear pump supplied a steady flow of water to the test section. The inlet temperature of the water loop was held constant for each test with a water chilled heat exchanger and variable electric heaters. The refrigerant and water flow rates were controlled by varying the pump speeds using frequency inverters. Redundant flow rate measurements were made with Coriolis flowmeters and with turbine flowmeters for both the refrigerant and water sides.

Figure 2 shows a cross section of the test section with a detail of the micro-fin tube geometry. The test refrigerant flowed inside a micro fin tube, while distilled water flowed either in counterflow or parallel flow to the refrigerant in the annulus that surrounded the micro-fin tube. The annulus gap was 2.2 mm, and the micro-fin tube wall thickness was 0.3 mm. The micro fin tube had 60, 0.2 mm high fins with 18 degree helix angle. For this geometry, the cross sectional flow area was 60.8 mm² giving an equivalent smooth diameter (D_e) of 8.8 mm. The root diameter of the micro-fin tube was 8.91 mm. The inside-surface area per unit length of the tube was estimated to be 44.6 mm. The hydraulic diameter (D_h) of the micro-fin tube was estimated to be 5.45 mm. The ratio of the inner surface area of the micro fin tube to the surface area of a smooth tube of the same D_e was 1.6. The fins rifled down the axis of the tube at a helix angle of 18° with respect to the tube axis.

Figure 3 provides a detailed description of the test section. The annulus was constructed by connecting a series of tubes with 14 pairs of stainless steel flanges. This construction permitted the measurement of both the outer micro-fin wall temperature and the water temperature drop as discussed in the following two paragraphs. The design also avoided abrupt discontinuities such as unheated portions of the test section and tube-wall "fins" between thermopile ends.

Figure 3 shows that thermocouple wires pass between 12 of the gasketed flange pairs to measure the refrigerant-tube wall temperature at ten locations on the top, side, and bottom of the tube wall. These locations were separated by 0.6 m on average, and they were located near the intersection of the shell flanges. In addition to these, thermocouples were also mounted near the middle pressure taps. The thermocouple junction was soldered to the outside surface and was sanded to a thickness of 0.5 mm. The leads were strapped to a thin non-electrically-conducting epoxy layer on the wall for a distance of 14.3 mm before they passed between a pair of the shell flanges. The wall temperature was corrected for a heat flux dependent fin effect. The correction was typically 0.05 K.

Figure 3 also shows that a chain of thermopiles was used to measure the water temperature drop between each flange location. Each thermopile consisted of ten thermocouples in series, with the ten junctions at each end evenly spaced around the circumference of the annulus. Because the upstream junctions of one thermopile and the downstream junctions of another enter the annulus at the same axial location (except at the water inlet and outlet), the junctions of the adjacent piles were alternated around the circumference. A series of teflon half-rings attached to the inner refrigerant tube centered the tube in the annulus. The half-rings were circumferentially baffled to mix the water flow. Mixing was further ensured by a high water Reynolds number (Kattan et al. 1995).

As shown in Fig. 3, six refrigerant pressure taps along the test section allowed the measurement of the upstream absolute pressure and five pressure drops along the test section. Two sets of two water pressure taps were used to measure the water pressure drop along each tube. Also, a sheathed thermocouple measured the refrigerant temperature at each end of the two refrigerant tubes, with the junction of each centered radially. Only the thermocouple at the inlet of the first tube was used in the calculations. The

entire test section was wrapped with 5 cm of foam insulation to minimize heat transfer between the water and the ambient.

HEAT TRANSFER COEFFICIENTS

The convective condensation heat transfer coefficient based on the actual inner surface area ($h_{2\phi}$) was calculated as:

$$h_{2\phi} = \frac{q''}{T_r - T_w} \quad (1)$$

where the measured wall temperatures (T_w) were fitted to their axial position to reduce the uncertainty in the measurement. The best fits for the wall temperature for parallel flow and counterflow differed. The measured wall temperatures for counterflow were fitted to:

$$T_w = A_0 + A_1 z^2 \quad (2)$$

The measured wall temperatures for parallel flow were fitted to:

$$T_w = A_0 + A_1 z + A_2 z^2 \quad (3)$$

Figure 4 shows the estimated expanded uncertainty of the wall temperature fit for all the measured data as a function of thermodynamic quality. Figure 4 includes some data that was omitted from the correlation of the data as explained in the Results section. Circles and squares are used to designate counterflow and parallel flow, respectively. The uncertainty of most of the fitted wall temperatures was less than 0.5 K. The median of the uncertainty in T_w as shown in Table 1 was 0.35 K.

The water temperature (T_f) was determined from the measured temperature change obtained from each thermopile and the inlet water temperature measurement. The water temperature was regressed to the axial location of the thermopiles along the z -coordinate. As shown for the T_w regressions, the best fits for the water temperatures differed for parallel flow and counterflow. The water temperatures for counterflow were fitted to:

$$T_f = A_0 + A_1 z^2 + A_2 z^3 \quad (4)$$

The measured water temperatures for parallel flow were fitted to:

$$T_f = A_0 + A_1 z + A_2 z^2 + A_3 z^3 \quad (5)$$

The water temperature fits, the measured water mass flow rate (\dot{m}_f), and the properties of the water were used to calculate the local heat flux (q'') to the micro-fin tube based on the actual inner surface area:

$$q'' = \frac{\dot{m}_f}{\pi p} \left(c_{p_f} \frac{dT_f}{dz} + v_f \frac{dP_f}{dz} \right) \quad (6)$$

where p is the wetted perimeter of the inside of the micro-fin tube. The specific heat (c_p) and the specific volume (v_f) of the water were calculated locally as a function of the water temperature. The local, axial water temperature gradient (dT_f/dz) was calculated from a derivative of either eqn. 4 or eqn. 5 depending on the corresponding flow configuration. The water pressure gradient (dP_f/dz) was linearly interpolated between the pressure taps to the location of the wall thermocouples. The pressure gradient term was typically less than 3% of the temperature gradient term.

Figure 5 shows an example plot of the local heat flux as calculated from eqn. 6 versus thermodynamic quality. Counterflow and parallel flow heat flux profiles are compared for R134a at a Reynolds number of 15100 and a refrigerant pressure of 1160 kPa. The form of the counterflow and parallel flow differ, as suggested by the use of two different water temperature fits for the two flow conditions. The two flow conditions provided for a wider range of heat fluxes at a given thermodynamic quality. In this way, the sensitivity of the heat-transfer coefficient to the heat flux could be thoroughly investigated as a function of quality.

Figure 6 plots the relative uncertainty in the water temperature gradient (which is roughly equal to the uncertainty in the heat flux) versus thermodynamic quality. As shown in Fig. 6, the larger values of heat flux exhibit smaller relative uncertainties than the lower heat fluxes. For example, at low quality (low q'') much of the parallel flow data exhibits relative uncertainties greater than 20%. Similarly, the relative uncertainty of the counterflow data tends to increase for high quality (low q'').

The equilibrium refrigerant temperature (T_r) and all other thermodynamic and transport properties were calculated with version five of REFPROP (Huber et al. 1995) with enthalpy and pressure as inputs. The enthalpy of the refrigerant vapor at the inlet of the test section was calculated from its measured temperature and pressure. The subsequent drop in refrigerant enthalpy along the test section was calculated from the local heat flux and the measured refrigerant mass flow rate. The refrigerant pressures were measured at six pressure taps along the test section. The pressure was linearly interpolated between the taps. The average T_r was varied between 30 °C and 50 °C with approximately 5 K of superheat at the test section inlet.

Figures 7 and 8 illustrate the results of the above-described measurement procedure for counterflow and parallel flow conditions, respectively. The difference between the appearances of the water and refrigerant temperature profiles for parallel flow and counterflow demonstrates the need for different temperature versus distance regression forms for the two flow conditions. Figures 7 and 8 also show representative results of refrigerant and water pressure profiles for counterflow and parallel flow conditions, respectively.

The local Nusselt number (Nu) was calculated based on the actual inner surface area of the tube as:

$$Nu = \frac{h_{2\phi} D_h}{k_l} \quad (7)$$

Figure 9 shows the relative uncertainty of the Nu versus thermodynamic quality. Testing the two flow conditions also benefitted the correlation of data by providing complimentary uncertainty profiles with thermodynamic quality. For example, the uncertainty of the low quality, parallel flow Nusselt number data exhibits high uncertainties, while the low quality, counterflow data exhibits low uncertainties. Consequently, by testing with both flow conditions, much of the parallel flow data can be omitted from the correlation due to its high uncertainty, while still maintaining sufficient counterflow data in the low quality region to produce a valid correlation. Figure 9 shows that a similar, but opposite, scenario exists in the high quality region.

The cubic fit of the wall and water temperature profiles were within ± 0.8 K and ± 0.2 K, respectively, of the measured temperatures. On average, the residual standard deviation of the wall and water temperature fits was 0.5 K and 0.1 K, respectively. The refrigerant temperatures were obtained from pressure measurements and the REFPROP (Huber et al. 1995) equation of state.

Figure 10 provides corroboration of the present local heat flux and wall temperature measurements with the Wiegand (1945) correlation for single phase turbulent heat transfer in a smooth annulus. The local heat flux, measured wall and water temperatures were used to calculate the local water-side heat transfer coefficient for the annulus. Figure 10 shows that approximately 80% of the measured water-side heat transfer coefficients are within $\pm 25\%$ of the Wiegand (1945) correlation. The range of the difference

between measurements and Wiegand's (1945) correlation is nearly centered about the correlation and lies within $\pm 36\%$ which was the range given by E. L. McMillen for his data in the "Written Discussion" section of Wiegand's (1945) paper. This provides an independent validation of the wall temperature and heat flux measurements.

Table 1 shows the expanded measurement uncertainty (U) of the various measurements along with the range of each parameter in this study. The U was estimated with the law of propagation of uncertainty. All expanded measurement uncertainties are reported for a 95% confidence interval and are evaluated by statistical methods. The estimates shown in Table 1 are median values of U for the correlated data.

RESULTS

The 1367 data points generated in this study for R32, R125, R410A, and R134a are tabulated in three separate appendices. Appendix A contains the pressure drop data. Appendix B contains the Nusselt and Reynolds numbers and other reduced data that were used in the correlation of the data. Appendix C contains the raw data measurements including the heat flux and the wall and water temperatures and locations. The column entitled, "flow," provides a "C" or a "P" for counterflow or parallel flow, respectively. All the parameters are defined in the nomenclature.

Heat Transfer

The present heat-transfer measurements concur with the approximate magnitude of the heat transfer enhancement reported by Webb (1994). Webb (1994) states that the micro-fin tube provides anywhere from 100% to 200% improvement over smooth tube R22 condensation performance. Figure 11 shows a graph of the condensation heat-transfer enhancement ratio (E_h),

$$E_h = \frac{h_{2\phi} A_i}{h_p \pi D_e L} \quad (8)$$

versus Reynolds number. The heat-transfer coefficient of the plain surface (h_p) was calculated from the smooth tube convective condensation correlation of Ackers and Rosson (1960) using the equivalent diameter (D_e) to calculate the Reynolds and Nusselt numbers. The h_p was calculated using the same mass velocity and fluid properties that were used for the experimental data.

The enhancement ratio shown in Fig. 11 varies from approximately 0.6 to 3.6 for the micro-fin tube. Approximately half of the enhancement factors are greater than 1.6. Enhancement ratios below 1.6 indicate that the micro-fin heat transfer coefficient based on the surface area is less than that of a smooth tube. Enhancement ratios greater than 1.6 suggest that the enhancement caused by the micro-fin surface is due to more than just the 60% surface area increase over the smooth surface with the same cross sectional flow area.

Regression of dimensionless parameters against E_h was used to assist in the investigation of the mechanism that was responsible for the heat transfer enhancement. The E_h was found to be primarily a function of Reynolds number and thermodynamic quality:

$$E_h = 9.777 \text{ Re}^{-0.162} x_q^{0.411} \quad (9)$$

The relative magnitude of the exponents in eqn. 9 shows that the quality has more influence on the E_h than does the Re. The negative exponent on the Reynolds number shows that the effectiveness of the micro-fin enhancement mechanism decreases for increasing Reynolds numbers. Conversely, eqn. 9 shows that the micro-fin enhancement mechanism is more effective for larger values of quality. The enhancement mechanism with respect to increasing quality may result from an interaction between the fins and the liquid-vapor interface of the fluid in the tube. At very high vapor qualities and very thin liquid films on the surface, the fins may be very effective at mixing the liquid-vapor interface due to their

proximity to the liquid-vapor interface. It is also possible to obtain an additional enhancement at very high qualities from surface-tension drainage forces on the fin-tips. However, as the liquid accumulates on the surface, both the liquid-vapor interface mixing and the surface-tension effects diminish. Consequently, the E_h is larger at higher qualities. The heat transfer enhancement with respect to the Reynolds number may result from an interaction between the fins and the turbulence in the liquid film. Smaller eddies transfer momentum more efficiently than larger eddies. Low Reynolds number flows may be enhanced more readily than high Reynolds number flows due to the reduction in the size of the turbulent eddies at the wall by the interaction of the flow with the fins. High Reynolds number flows are not enhanced as readily as low Reynolds number flows because there are fewer large eddies to be reduced at higher Reynolds numbers.

The enhancement ratio that Schlager et al. (1989) obtained for the same micro-fin tube as used in this study is presented as solid, white lines in Fig. 11. They used a global micro-fin heat transfer coefficient measurement over a 0.6 to 0.8 quality change to calculate E_h . For the reference case, Schlager et al. (1989) measured smooth tube heat transfer coefficients for an 8 mm inner diameter tube. The solid white line shows the enhancement ratio as reported by Schlager et al. (1989) using the 8 mm diameter tube in its calculation. The dashed line shows the E_h after the smooth tube conductance was multiplied by $(8/8.8)^{0.8}$ to convert to an E_h based on a 8.8 mm smooth inner diameter, i.e., D_e for the micro-fin. The Reynolds number and quality dependence of the Schlager et al. (1989) E_h roughly agrees with the present E_h measurement. The slope of the Schlager et al. (1989) is consistent with the mean slope of the measurements. Considering that the Schlager et al. (1989) E_h is for average heat transfer conditions, their data would be expected to lie close to the middle of the data range. The Schlager et al. (1989) enhancement ratio that was adjusted to the 8.8 mm diameter lies relatively close to the median of the data.

Figure 12 includes a comparison of the experimental micro-fin Nusselt numbers to the smooth tube convective condensation correlation of Ackers and Rosson (1960) using the hydraulic diameter to calculate the Reynolds and Nusselt numbers. The figure shows that use of the hydraulic diameter in a smooth tube condensation correlation predicts most of the present micro-fin data to within +20% and -40%. The majority of the data is under-predict with the Ackers and Rosson (1960) correlation. Apparently, the smooth tube correlation does not account for the flow enhancement provided by the fins. Consequently, a new correlation is needed to account for the heat transfer enhancement due to the micro fins.

The convective condensation Nusselt numbers (Nu) were correlated following the law of Corresponding States philosophy presented by Cooper (1984). Cooper (1984) suggested that the fluid properties that govern nucleate pool boiling can be well represented by a product of the reduced pressure (P_r/P_c), the acentric factor ($-\log_{10}(P_r/P_c)$), and other dimensionless variables to various powers. The above reduced pressure terms and several other locally evaluated terms were used to correlate the 1358 (see table 2) measured local Nu for all condensing flow conditions and refrigerants in this study to:

$$Nu = \frac{h_{2\phi} D_h}{k_f} = 2.256 Re^{\beta_1} Ja^{\beta_2} Pr^{\beta_3} \left(\frac{P_r}{P_c} \right)^{\beta_4} \left(-\log_{10} \frac{P_r}{P_c} \right)^{\beta_5} Sv^{\beta_6}$$

where:

$$\begin{aligned} \beta_1 &= 0.303 \\ \beta_2 &= 0.232x_q \\ \beta_3 &= 0.393 \\ \beta_4 &= -0.578x_q^2 \\ \beta_5 &= -0.474x_q^2 \\ \beta_6 &= 2.531x_q \end{aligned} \tag{10}$$

where the Reynolds number (Re), the Jacob number (Ja), the Prandtl number (Pr), the reduced pressure (P_r/P_c), the dimensionless specific volume (S_v) and the quality (x_q) are all evaluated locally. Baker's (1954) flow map for smooth tubes was used to approximately determine the flow conditions. The results showed that 79%, 18%, 2%, and 1% of the data were in annular, slug, bubbly, and wavy flow, respectively.

The search for the above form of the correlation began with quadratic exponents in quality for each dimensionless variable. The quadratic exponent form was used with good results by Kedzierski and Kim (1997) to correlate several other pure refrigerants and mixtures for a wide range of qualities for both evaporative and condensing flows. The number of dimensionless variables and constants in the exponents were reduced to only those with significant influence on the residual standard deviation of the fit. For example, because R410A is a near-azeotrope, the composition difference between vapor and liquid phases had a negligible influence on the fit of the correlation. Consequently, the composition difference was not used in the fit of the data.

Not all of the 1367 data points were used in the regression of eqn. 10. Table 2 shows the number of data points for each refrigerant that were not used in the fit. Measurements with large uncertainties, and measurements that had high influence, or high leverage on the model were all candidates for exclusion from the regression. The last column in Appendix B shows the data points that were included and excluded from the fit. The letter I signifies that the data point was included in the fit. The letters HI identifies that data point as being omitted for exhibiting high influence on the regression. The letters HL stand for omitted data points associated with high leverage. The letters HC represent high influence and high leverage data points.

The process that was used to determine which measurements were not to be included in the regression is outlined below. First, the form of eqn. 10 was determined using only those data points with an estimated expanded uncertainty less than 25% and qualities less than 1. This process removed 686 data points, leaving no data with Nusselt numbers greater than approximately 300 in the included data set. Next, the 686 measurements that were omitted from the first regression were predicted with that same regression using the dimensionless parameters. Those excluded measurements that were predicted to within $\pm 25\%$ of the first correlation were reintroduced into the regression data set. This process reintroduced Nusselt numbers greater than 300 to the regression data set. New coefficients were generated for eqn. 10 using the 1417 measurements of the regression data set. Measurements that were omitted from the regression with this first pass are designated with "O2" in the last column of Appendix B. The hat matrix and Cook's distance were generated for the second regression and used to determine which data had high-leverage and influence on the model, respectively. The diagonal elements of the hat matrix that were greater than approximately $2d/n$, where d is the number of model parameters, and n is the number of data points, were designated as high-leverage points (Belsley et al., 1980). The elements of the Cook array that were greater than $4/n$ were considered to be influential observations. The third stage of data filtering was performed by removing data: (1) that exhibited both high influence (i.e., $4/n > 0.01$) and great leverage (i.e., $2d/n > 0.003$) or (2) where the estimated uncertainty was greater than 25%, and where the data had a large influence on the fit (shown as CU in last column of Appendix).

Most of the data that satisfied the last two criteria were data at or near the inlet and exit of the test section. There were nearly as many outliers at the inlet as there were for the outlet of the test section. Outliers at the inlet and outlet of the test section are consistent with the largest uncertainties in the water and wall temperature fits being located at the inlet and outlet. Also, the ΔT_s can be less than the uncertainty of the measurement at the refrigerant inlet and outlet of the test section for counterflow and parallel flow, respectively.

Figure 13 compares the measured condensation Nusselt numbers for the micro-fin tube to the Nusselt numbers predicted with equation 10. Equation 10 correlates 95% of the pure component and near-azeotropic convective condensation Nusselt numbers to within approximately $\pm 21\%$. The mean of the correlation has an average uncertainty of $\pm 3\%$ over the entire range of Nusselt numbers. Only random

trends were observed in the residual plots against each of the parameters of eqn. 10. The residual standard deviation of eqn. 10 and that for the separate fits for each fluid were nearly the same. This suggests that the scatter in the data is not caused by the different fluids.

A simpler form of eqn. 10 with a larger uncertainty is:

$$\text{Nu} = \frac{h_{2\phi} D_h}{k_f} = 4.94 \text{ Re}^{\beta_1} \text{Pr}^{\beta_3} \left(\frac{P_r}{P_c} \right)^{\beta_4} \left(-\log_{10} \frac{P_r}{P_c} \right)^{\beta_5} \text{Sv}^{\beta_6}$$

where:

$$\begin{aligned} \beta_1 &= 0.235 \\ \beta_3 &= 0.308 \\ \beta_4 &= -1.16x_q^2 \\ \beta_5 &= -0.887x_q^2 \\ \beta_6 &= 2.708x_q \end{aligned} \tag{11}$$

Equation 11 does not require an iteration procedure on the ΔT_s to evaluate the Jacob number. However, the uncertainty of fit is approximately 23.5% which is larger than that of eqn. 10.

Figure 14 shows the heat transfer coefficient versus quality for each of the four test fluids at $T_r = 40^\circ\text{C}$, $\Delta T_s = 5\text{ K}$, and $G_r = 250\text{ kg}/(\text{m}^2\cdot\text{s})$. The solid lines are predictions for the present micro-fin tube geometry which were obtained from the correlation of the data given as eqn. 10. In general, the measured condensation heat-transfer coefficient decreases for decreasing qualities. Apparently, thin liquid films and high vapor velocities at the entrance of the tube provide for high heat-transfer coefficients. As the liquid accumulates on the tube wall for decreasing quality, the heat-transfer coefficient diminishes. The refrigerant R32 exhibits the highest heat transfer performance of the four test fluids. R32 owes much of its heat transfer performance to its high thermal conductivity. As expected, the performance of the near-azeotropic mixture R410A is between that of its pure components R32 and R125. The predicted performance of R22 is near that of its proposed replacement R410A. The R125 exhibits lower condensation Nusselt numbers than that for R134a for the above conditions. Conversely, as shown by Kaul et al. (1996), the flow boiling performance of R125 is greater than that of R134a in the identical tube.

Over 140 figures would be required to depict the Nusselt number versus thermodynamic quality relationships for each test. Consequently, only representative plots of Nu versus x_q are given in Figs. 15 through 18. Each figure compares counterflow to parallel flow for nominally the same Reynolds number and reduced pressure. The solid lines are predictions for the present micro-fin tube geometry which were obtained from the correlation of the data given as eqn. 10. The symbols are the measured data points. In general, parallel flow exhibits larger Nusselt numbers for the 0.3 to 0.7 quality range. Below and above this range, the Nusselt numbers for counterflow and parallel flow nearly coincide. Both the Nusselt number measurements and the predictions for counterflow are concave with respect to quality. By contrast, the parallel flow Nusselt number measurements and predictions are convex with respect to quality. The difference in the Nusselt numbers in the mid-quality range may be due to the difference in the heat flux versus quality relationship between counterflow and parallel flow. The exact mechanism that is responsible for the difference between counterflow and parallel flow is not fully understood. Although the correlation predicts both the concave and convex trends with respect to quality, it, apparently, does not account for the entire difference between Nusselt numbers for the two flow conditions. Equation 10 consistently under-predicts the counterflow Nusselt numbers and over-predicts the parallel flow Nusselt numbers.

Figure 19 compares the predictions of eqn. 4 to the local condensation heat transfer data that was available in the literature. All of the heat transfer coefficients taken from the literature were read from graphs and given based on the root-diameter area. Consequently, all of the heat transfer coefficients from the literature had to be adjusted so that they were based on the actual inner surface area of the tube in order to compare the literature data with eqn. 10. Cross-sectional schematics and tabulated dimensions of the tubes were used to calculate the surface areas and the hydraulic diameters of the micro-fin tubes from:

$$D_h = \frac{4A_c \cos \alpha}{N_f S} \quad (12)$$

where S is the perimeter of one fin and channel taken perpendicular to the axis of the fin, N_f is the number of fins, A_c is the cross-sectional flow area, and α is the helix angle of the fin.

Mori and Nakayama (1983) measured R113 quasi-local condensation heat transfer coefficients for three different micro-fin tube geometries. The Mori and Nakayama (1983) data for a 9.5 mm outer diameter tube with 60, 0.16 mm high micro fins at a 20° helix angle are presented as closed circles in Fig. 19. The Mori and Nakayama (1983) data presented in Fig. 19 are for a mass velocity of 160 kg/m²•s. Most of this data lies within $\pm 20\%$ of the predictions. Chiang (1993) graphically presented measured quasi-local condensation heat transfer coefficient for one of four micro-fin tube geometries that he tested. The local heat flux was estimated from $dx_q/dz = 0.09/\text{m}$ which was given by Chiang (1993). The Chiang (1993) data for R22 in a 10 mm outer diameter tube with 60, 0.18 mm high micro fins at a 18° helix angle and a mass velocity of 600 kg/m²•s are presented as closed rectangles in Fig. 19. Most of the Chiang (1993) data lies just below the 20% under-prediction line. The quasi-local condensation heat transfer measurements of Khanpara et al. (1986) for three different mass velocities (223 kg/m²•s, 378 kg/m²•s, and 570 kg/m²•s) are shown as closed diamonds in Fig. 19. The local heat flux was estimated from quality change over the test section which was given as from 0.2 to 0.3. The measured Nusselt numbers of Khanpara et al. (1986) for their intermediate mass velocity of 378 kg/m²•s lie very close to those predicted by eqn. 10. However, the high-quality region of the low mass velocity data (223 kg/m²•s) are over-predicted by more than 20%. Similarly, nearly all of the high mass velocity (570 kg/m²•s) Nusselt numbers are under-predicted by approximately 30%.

The data from the literature are all within the mass velocity limits for which the correlation was developed. Also, the e/D_i ratios for the tubes from the literature, with the exception of the Mori and Nakayama (1983) data, are approximately equivalent to the present tube (0.02). However, considering the wide range of tube diameters, helix angles, fluids, fin shapes, and estimates made for the literature data, the agreement between eqn. 10 and Nusselt numbers from the literature is to be expected. Also, it is very difficult to estimate the hydraulic diameter not knowing the exact pattern of the fins. This is especially true for the Chiang (1993) data which was for mechanically expanded micro-fin tubes. Certainly, the mechanical expansion process altered the fin profiles and increased the overall diameter of the tube. If a larger hydraulic diameter were to be used in the predictions, the Chiang (1993) agreement between the predictions and measurements would improve.

Although, eqn. 10 predicts the micro-fin data fairly well, the predictions of the cross-grooved micro-fin data of Chamra and Webb (1995) are under-predicted on average by 40%. Possibly, the cross grooves provide an additional enhancement that is not accounted for by eqn. 10. The process of forming the cross groove creates a bump or a spill over into the major groove. The additional enhancement could be due to the high heat transfer that would occur on the leading edge of the bump. Equation 4 cannot account for the enhancement due to the bump. Also, the cross groove tubes were created from flat stock with a "W-shaped" fin axis then seam welded. Consequently, the main fin axis of the cross grooved tube did not rifle down the axis. Possibly, the non-spiraling fin also contributed to a difference in performance from the eqn. 10 prediction.

Figure 20 shows the heat transfer degradation ($\Delta h_{2\phi}$) as a function of heat flux for the R410A mixture at a mass flux of 246 kg/m² s. The $\Delta h_{2\phi}$ was calculated from the correlations using the same definition as given in Kedzierski et al. (1992):

$$\Delta h_{2\phi} = h_L - h_{2\phi} \quad (13)$$

where h_L is the heat transfer coefficient obtained from a linear interpolation of the pure components at a given composition. The heat transfer degradation is independent of heat flux and no greater than 2.5%. The average difference between the vapor and liquid concentration was 0.02 mole, suggesting that the degradation was mostly due to property effects.

Pressure Drop

Pierre (1964) developed the following semi-empirical equation to predict the pressure drop for flow boiling in a horizontal smooth tube:

$$\Delta P = \left(0.0185 \left(\frac{\Phi}{Re} \right)^{1/4} + \frac{\Delta x_q D_h}{x_{qm} \Delta L} \right) \frac{\Delta L}{D_h} G^2 x_{qm} v_v \quad (14)$$

where the specific volume of the vapor (v_v), the Reynolds number, the mass velocity (G), and the two-phase number ($\Phi = \frac{\Delta x_q i_{fg}}{\Delta L g}$) are evaluated at the average temperature of the refrigerant. The average quality over length ΔL is x_{qm} . The above correlation originates from the first law of thermodynamics. The first term within the bracket represents the dimensionless friction factor. The second term is from the acceleration portion of the pressure drop. Pierre (1964) fitted his pressure drop measurements to eqn. 6 to obtain an expression for the friction factor. With the exception of the friction factor which may be germane to flow boiling, eqn. 6 applies to condensation as well as to evaporation. One might expect that pressure drops due to flow boiling (in the absence of nucleate boiling) and condensation may be governed by the same physical phenomenon. If so, then the Pierre (1964) correlation should work as well for convective condensation as it does for convective evaporation.

Figure 21 compares the micro-fin condensation pressure drop to Pierre (1964) flow boiling pressure drop correlation. The hydraulic diameter was used in the Pierre (1964) correlation to predict most of the condensation pressure drop measurements in the present micro-fin tube to within $\pm 20\%$. Pierre recommends that eqn. 14 not be used for values of $\frac{Re L}{\Delta x_q i_{fg}}$ greater than 1. Only three data points in the present data set violated this criteria. Overall, the Pierre (1964) correlation predicts the present convective condensation pressure drop measurements for the micro-fin tube acceptably well. However, the mean of the predictions lies slightly below the ideal prediction line.

Following the development of the Pierre (1964) pressure drop equation, the Fanning friction factor for the present data was calculated as:

$$f_r = \frac{D_h}{(v_o + v_i) \Delta L} \left(\frac{(P_i - P_o)}{G^2} - (v_o - v_i) \right) \quad (15)$$

where specific volume of the fluid (v) was calculated from a thermodynamic quality weighted average of the liquid and vapor specific volumes. Only the two central portions of the test section (Fig. 3) were

used to ensure that all of the correlated data were for two-phase flow. Appendix A shows the data that was used to calculate the friction factor from eqn. 14.

In order to center the friction factor predictions about the data, the measured friction factors were regressed to the following:

$$f_r = 0.00228 \text{ Re}^{-0.062} \Phi^{0.211} \quad (16)$$

Twenty-six data points were removed from the fit because they had high influence and high leverage on the fit. The deleted data were for somewhat low pressure drop values which are associated with larger relative measurement uncertainties.

The exponent on the two-phase number given in eqn. 16, 0.211, is consistent with that given by Pierre (1964): 0.24. However, the exponent on the Reynolds number, -0.062, is very different from that given by Pierre (1964): -0.24. The exponent on the Reynolds number of eqn. 16 is approximately equivalent to -0.06 which is the exponent that one would calculate from the transition zone of the Moody (1944) chart using the fin height (2mm) for the roughness height. Consequently, the new friction factor should be more appropriate for micro-fins because it accounts for the influence of the fins on the flow.

The fact that the Reynolds number exponent is consistent with that obtained from the Moody (1944) chart suggests that the fins of a micro-fin tube act like a roughness to enhance the convective condensation heat transfer. If roughness mixing dominates the enhancement mechanism, neither swirl effects nor surface-tension drainage have much influence on the heat transfer. The lack of importance of surface-tension and swirl flow may be a consequence of the flow conditions and surface geometry. It may be possible that the roughness effect would not dominate for other flow conditions and micro-fin tubes with larger heights.

The corroboration between the present Re exponent and Moody's (1944) also suggests that the frictional pressure drop of micro-fin tubes should depend on the fin-height-to-root-tube-diameter (e/D_i) ratio. If it is assumed that the fins act purely as a roughness, the Moody (1944) chart can be used to interpolate between the eqn. 16 friction factor and Pierre's (1964) smooth tube friction factor for a given e/D_i ratio as follows:

$$f_r = \left(0.002275 + 0.00933 \exp\left(\frac{e/D_i}{-0.003}\right) \right) \text{Re}^{\frac{-1}{4.16+532 \frac{e}{D_i}}} \Phi^{0.211} \quad (17)$$

In the above equation, the functional forms of the leading coefficient and the Reynolds number exponent with respect to e/D_i were determined from the Moody (1944) chart. Also, Pierre's (1964) friction factor equation was modified for use in the interpolation. Namely, the exponent on the two-phase number of Pierre's (1964) friction factor correlation was set equal to that of eqn. 16 and the leading coefficient on Pierre's correlation was adjusted to give approximately the same results, for our data set, as the original equation.

The pressure drop equation for which eqns. 16 and 17 are valid is:

$$\Delta P = \left(\frac{f_r (v_o + v_i) \Delta L}{D_h} + (v_o - v_i) \right) G^2 \quad (18)$$

This is essentially the same equation as given by Pierre (1964) with the exception that the specific volume

of the liquid is not neglected. The uncertainty of the fit was reduced when the liquid specific volume was included.

CONCLUSIONS

Local convective condensation measurements for four refrigerant fluids: R134a, R410A(R32/R125, 50/50 % mass), R125, and R32 in a micro-fin tube were presented. Both heat transfer and pressure drop measurements were provided. The measured convective condensation Nusselt numbers for all of the test refrigerants were correlated to a single expression consisting of a product of dimensionless properties. The correlation was shown to predict existing condensation Nusselt numbers for micro-fins from the literature acceptably well. However, the correlation poorly predicted the Nusselt numbers for micro-fins with cross-grooves. It was speculated that bumps from the cross-grooves caused an additional enhancement that could not be accounted for by the correlation. The hydraulic diameter was used in an existing flow boiling correlation from the literature to predict most of the condensation pressure drop measurements in the present micro-fin tube to within $\pm 20\%$.

In general, the measured condensation heat-transfer coefficient decreased with decreasing qualities. The refrigerant R32 exhibited the highest heat transfer performance due to its high thermal conductivity. As expected, the performance of the near-azeotropic mixture R410A was between that of its pure components R32 and R125. The heat transfer degradation associated with R410A was shown to be relatively small and believed to be mostly due to nonlinear property effects.

The enhancement ratio was shown to span from 3.6 at low Re to 0.6 at high Re. It was speculated that the micro-fins enhanced the heat transfer with a combination of liquid-vapor interface mixing and turbulent mixing near the wall. The surface behaves as a roughness in the enhancement of the heat transfer. Surface-tension drainage and swirl effects are presumed to have little influence on the heat transfer. At high vapor qualities and thin liquid films on the surface, the fins act to mix the liquid-vapor interface. At lower vapor qualities and thicker liquid films on the surface, the fins have less influence on the liquid-vapor interface. The heat transfer enhancement with respect to the Reynolds number may result from an interaction between the fins and the turbulence in the liquid film. Low Reynolds number flows may be enhanced more readily than high Reynolds number flows due to the reduction in the size of the turbulent eddies at the wall by the interaction of the flow with the fins. High Reynolds number flows are not enhanced as readily as low Reynolds number flows because there are fewer large eddies to be reduced.

The condensation pressure drop for the micro-fin tube was predicted acceptably well with a modified form of the Pierre (1964) pressure drop correlation for convective evaporation. The hydraulic diameter was used and a new friction factor was developed to account for the fin effect on the flow. The influence of the fin height on the Reynolds number exponent was consistent with the Moody chart, suggesting that the surface behaves like a roughness in enhancing the heat transfer.

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Table 1 Median estimated 95% relative expanded uncertainties for eqn. 10 data

Parameter	Minimum	Maximum	U %
G_r [kg/m ² •s]	57	552	2.0
T_r [K]	293.0	323.0	0.1 (0.3 K)
P [kPa]	600	2000	1.5
T_w [K]	288.0	318.0	0.1 (0.35 K)
\dot{m}_f [kg/s]	0.0150	0.0450	2.0
T_f [K]	278.0	318.0	0.1
P_f [kPa]	200	110	1.0
q'' [kW/m ²]	0.72	39	5.1
dT_f/dz [K/m]	0.014	0.57	5.2
ΔT_s [K]	0.41	12.6	15.2 (0.44 K)
Nu	58	508	16.4
Re	3500	24000	1.0
Ja	6	256	16.4
Pr	1.7	3.6	2.0
P_r/P_c	0.22	0.62	2.0
Sv	0.86	10.3	3.0
x_q	0.06	1.0	8.0

Table 2 Data distribution

	R134a	R410A	R125	R32	Total
# tests	46	28	30	38	142
# points	552	336	360	456	1704
# pts used in fit	447	269	309	342	1367

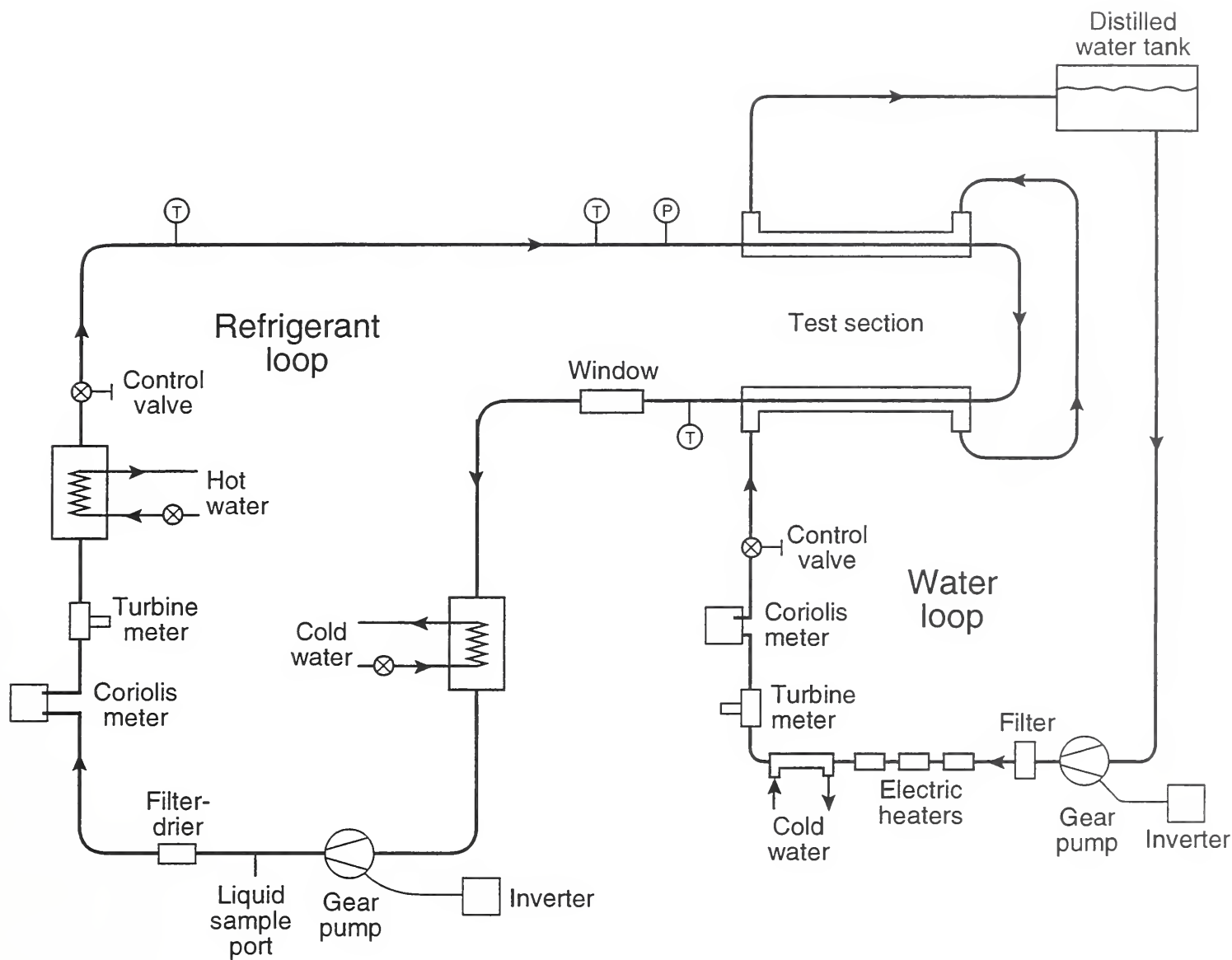


Fig. 1 Schematic of test rig

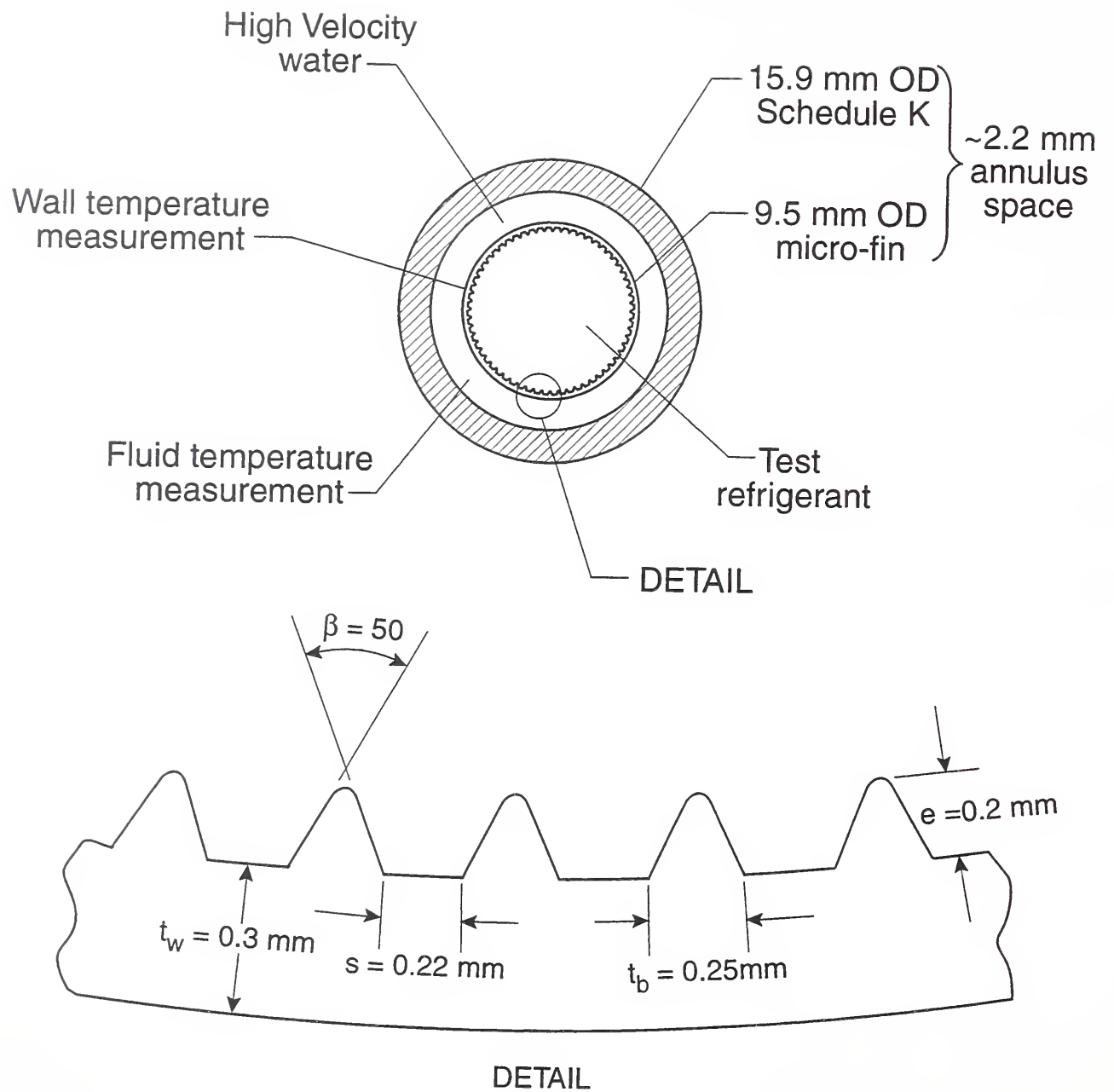


Fig. 2 Test section cross section

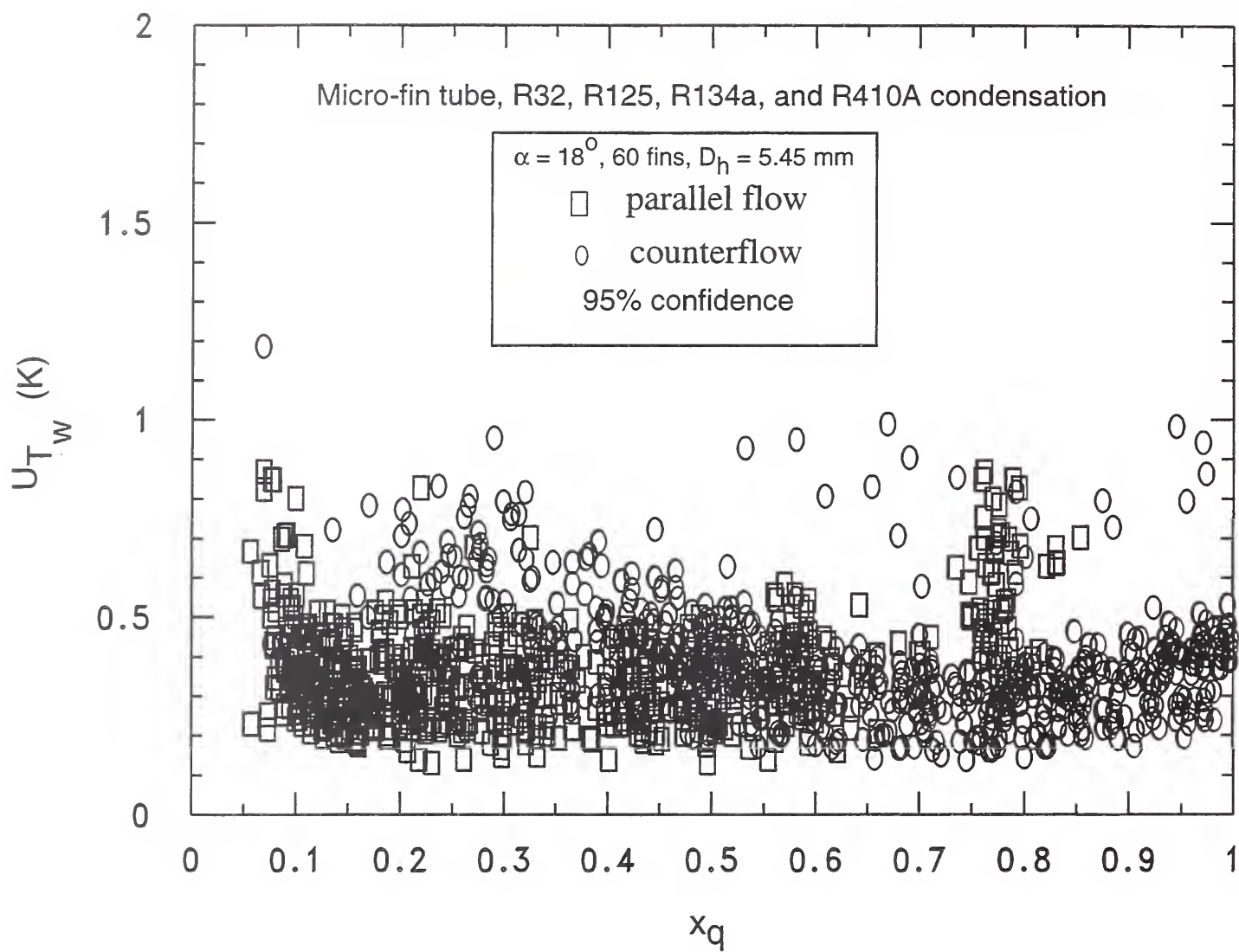


Fig. 4 Relative uncertainty of inner root surface temperature

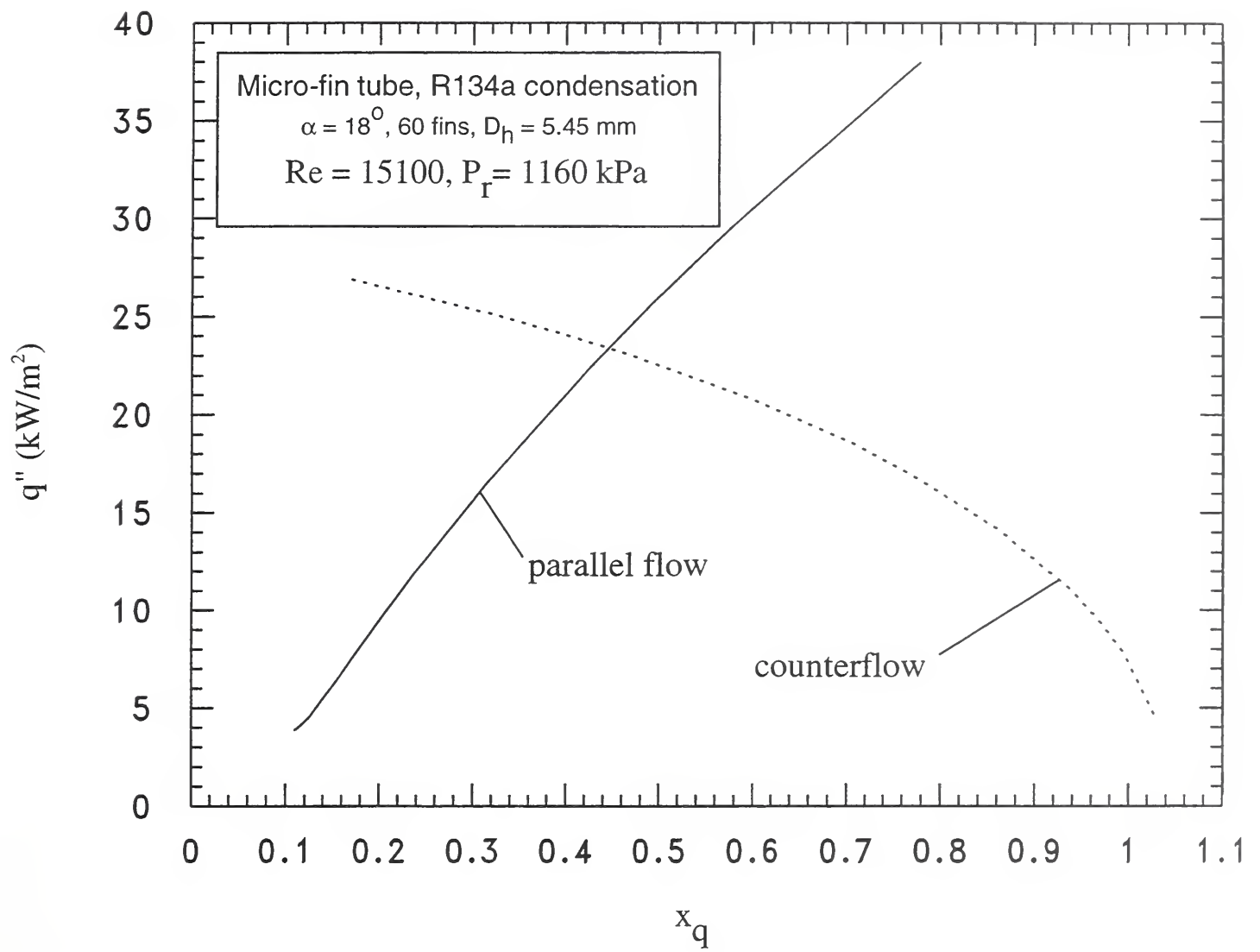


Fig. 5 Comparison of counterflow and parallel flow heat flux distributions

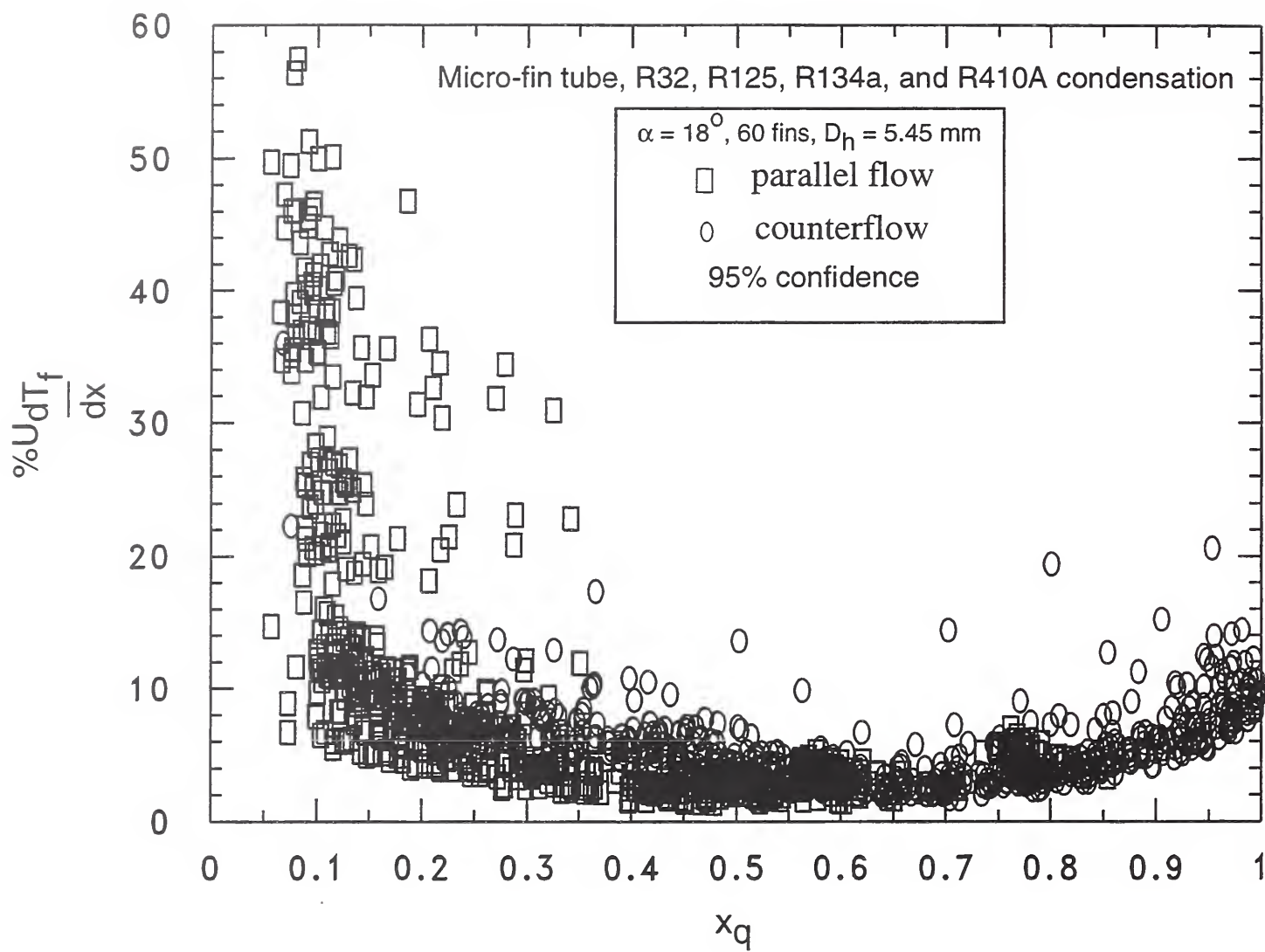


Fig. 6 Relative uncertainty of water temperature gradient with respect to quality

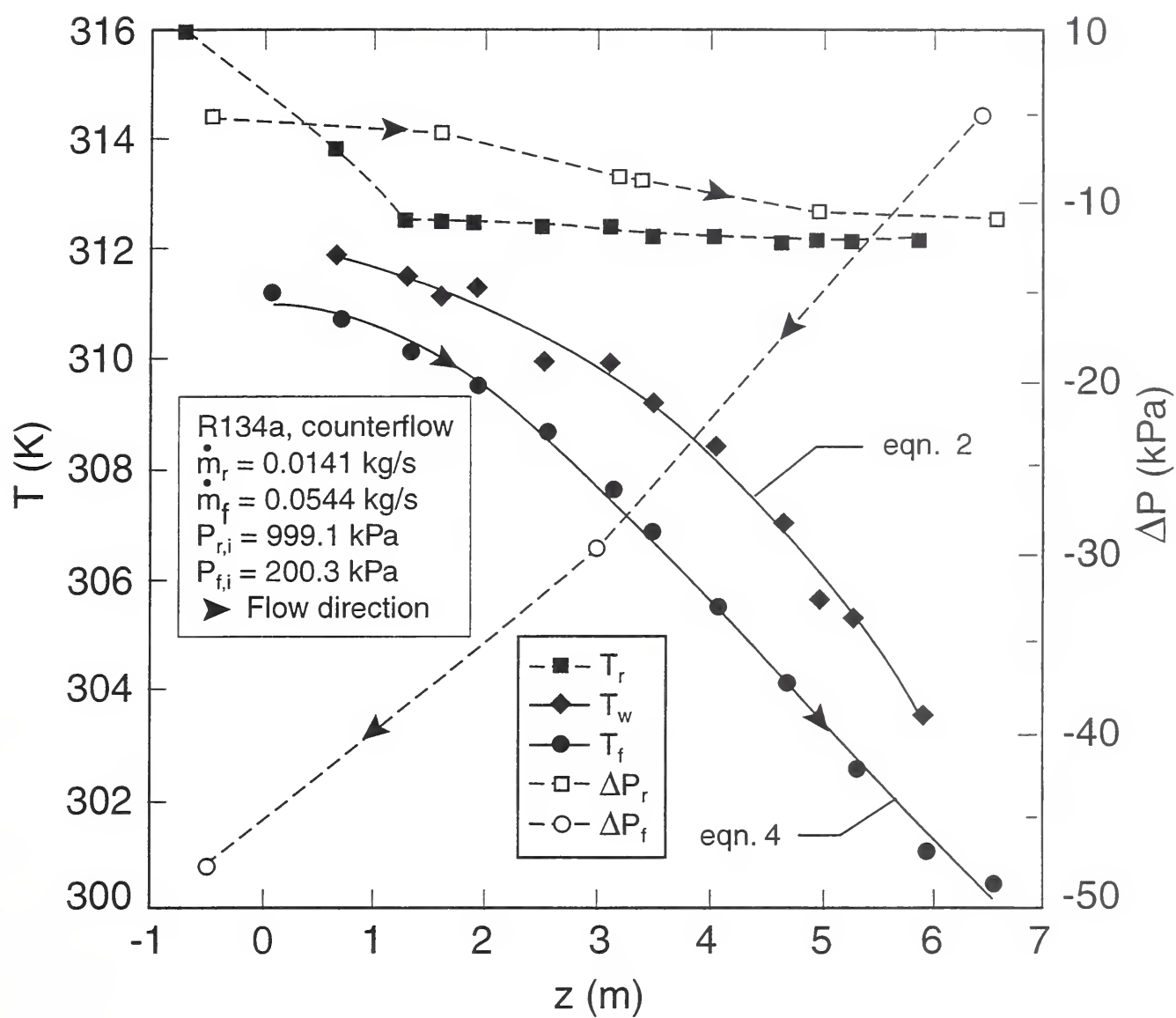


Fig. 7 Counterflow temperature and pressure profiles for a R134a test

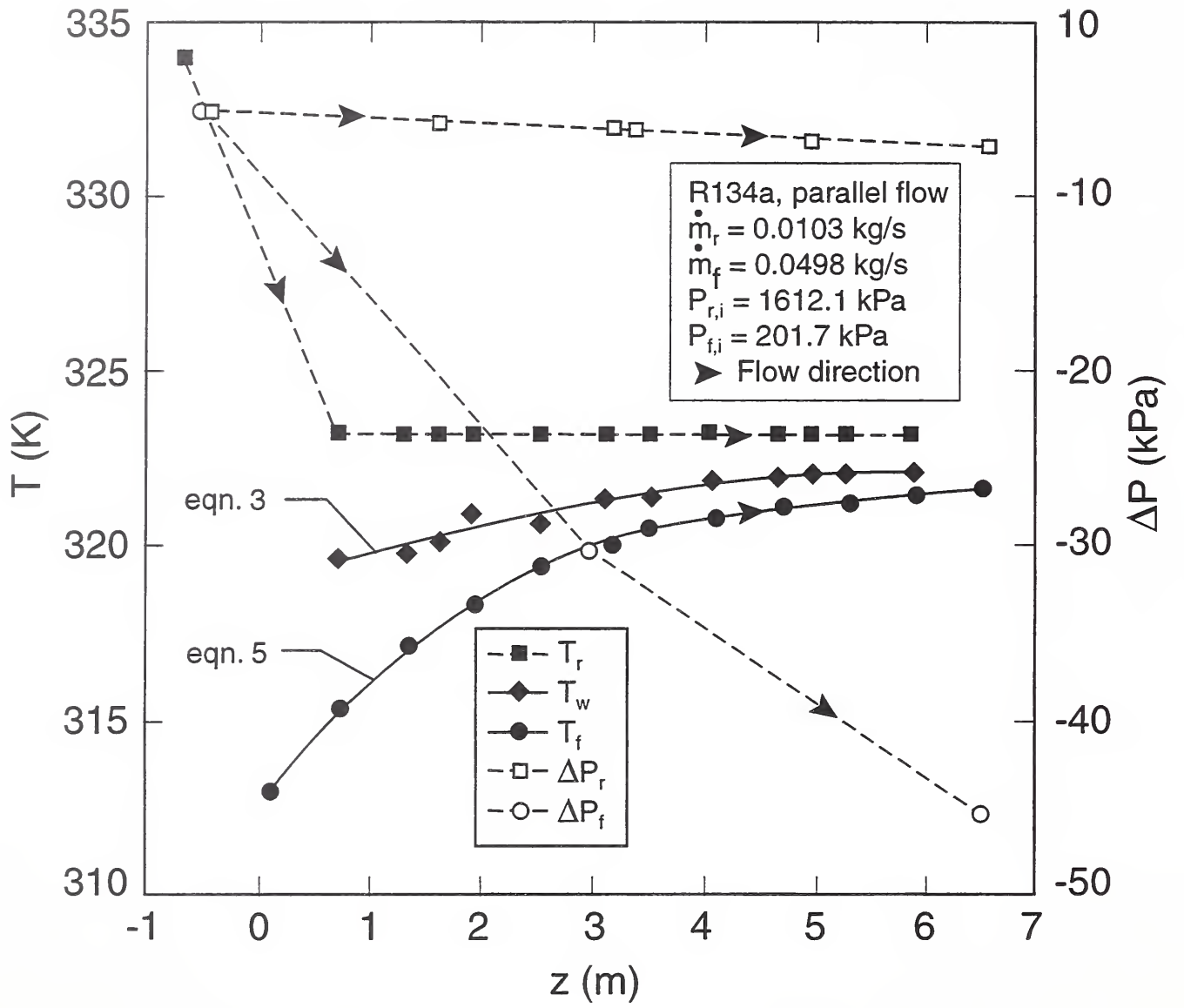


Fig. 8 Parallel flow temperature and pressure profiles for a R134a test

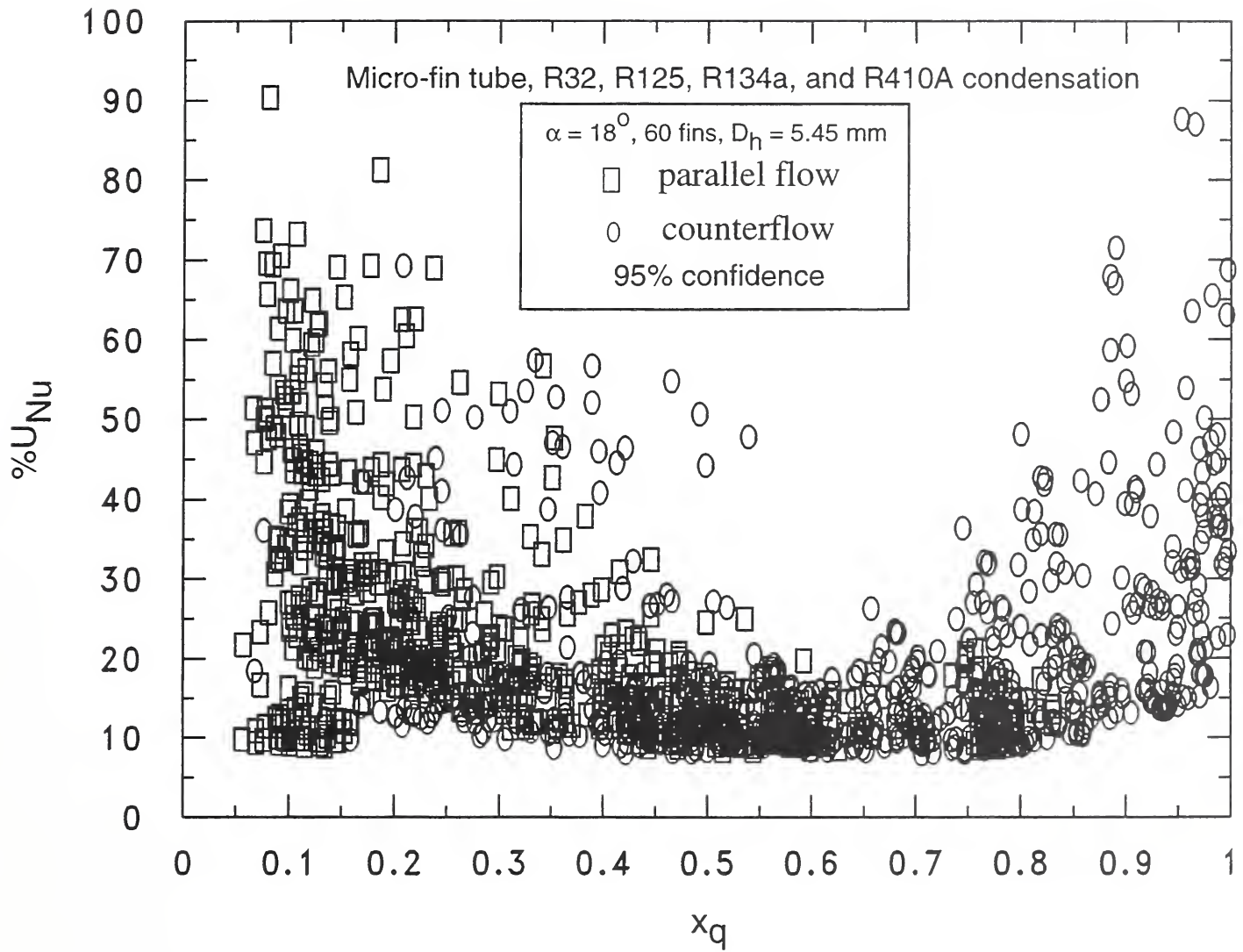


Fig. 9 Relative uncertainty of the Nusselt number with respect to the quality

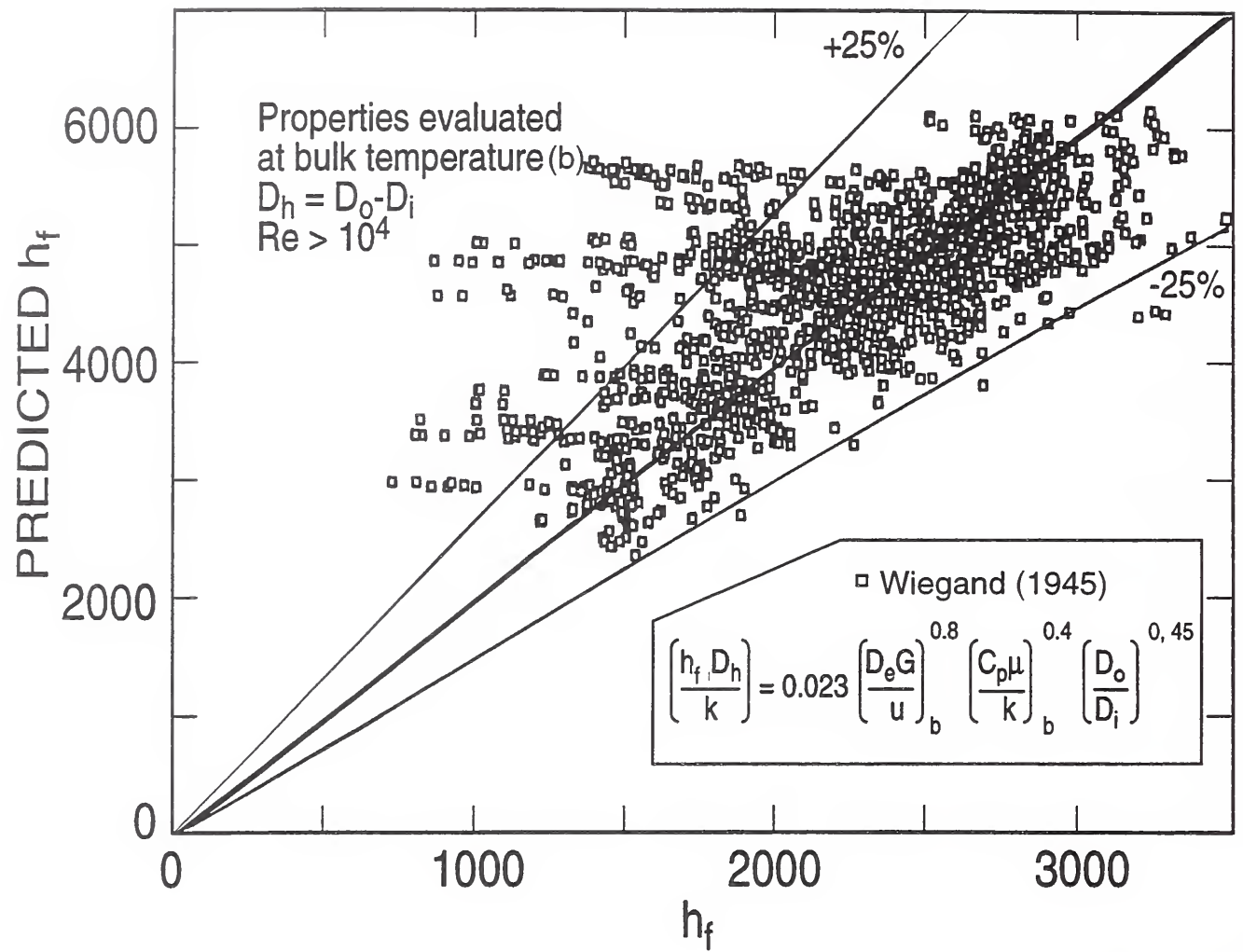


Fig. 10 Corroboration of measurement procedure

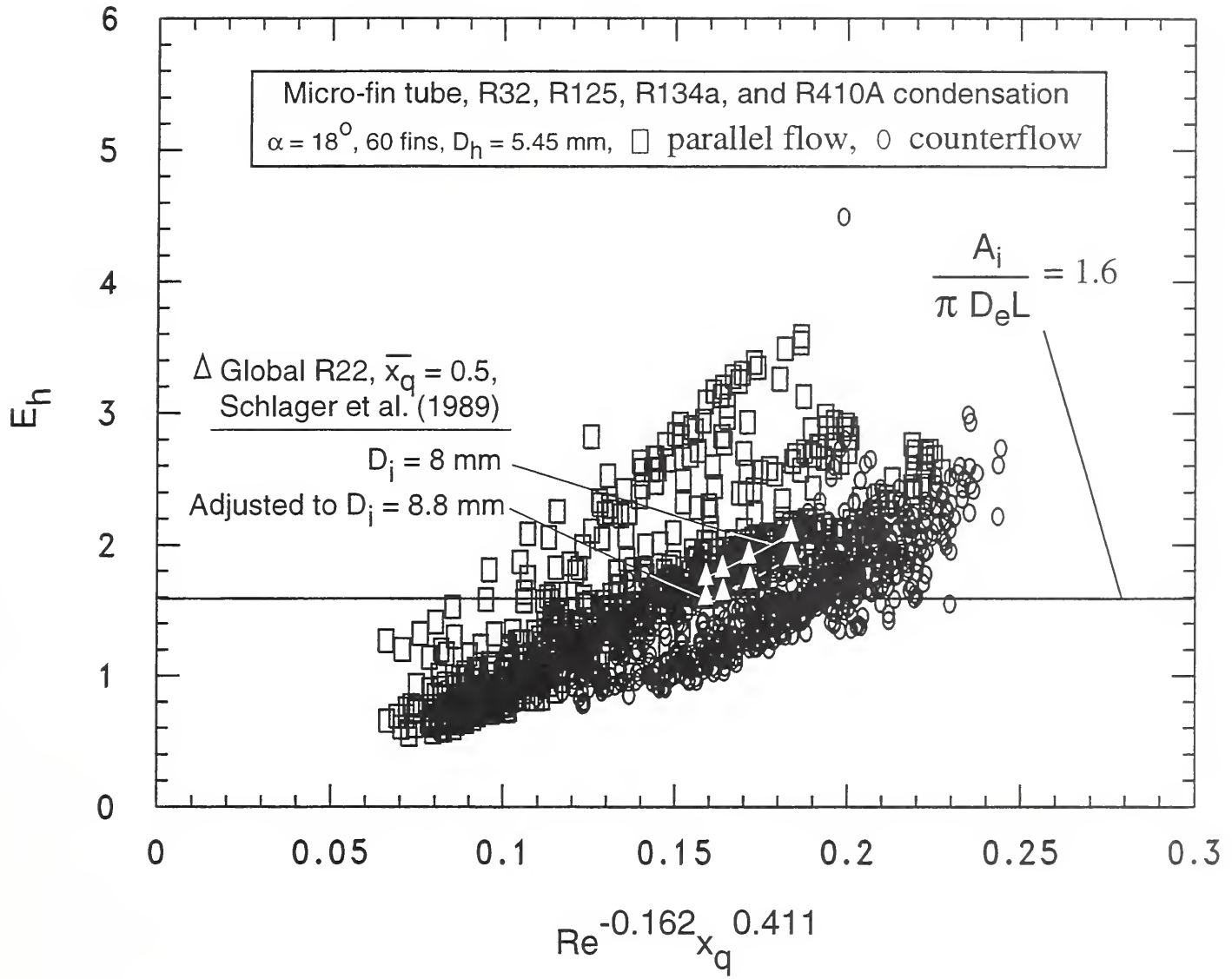


Fig. 11 Condensation heat transfer enhancement ratio for micro-fin tube

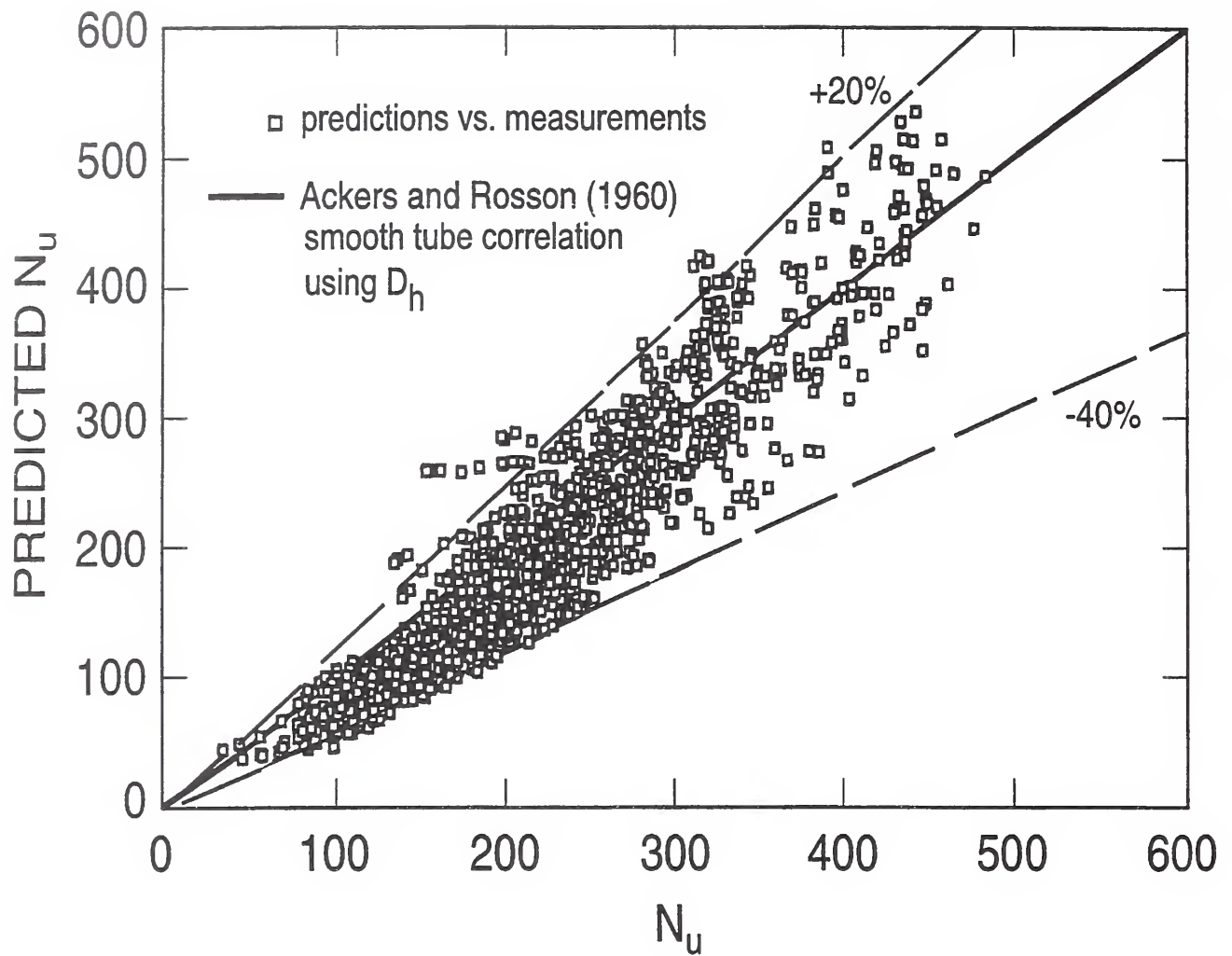


Fig. 12 Comparison of measured convective condensation Nusselt numbers to those predicted with Ackers and Rosen (1960) using D_h

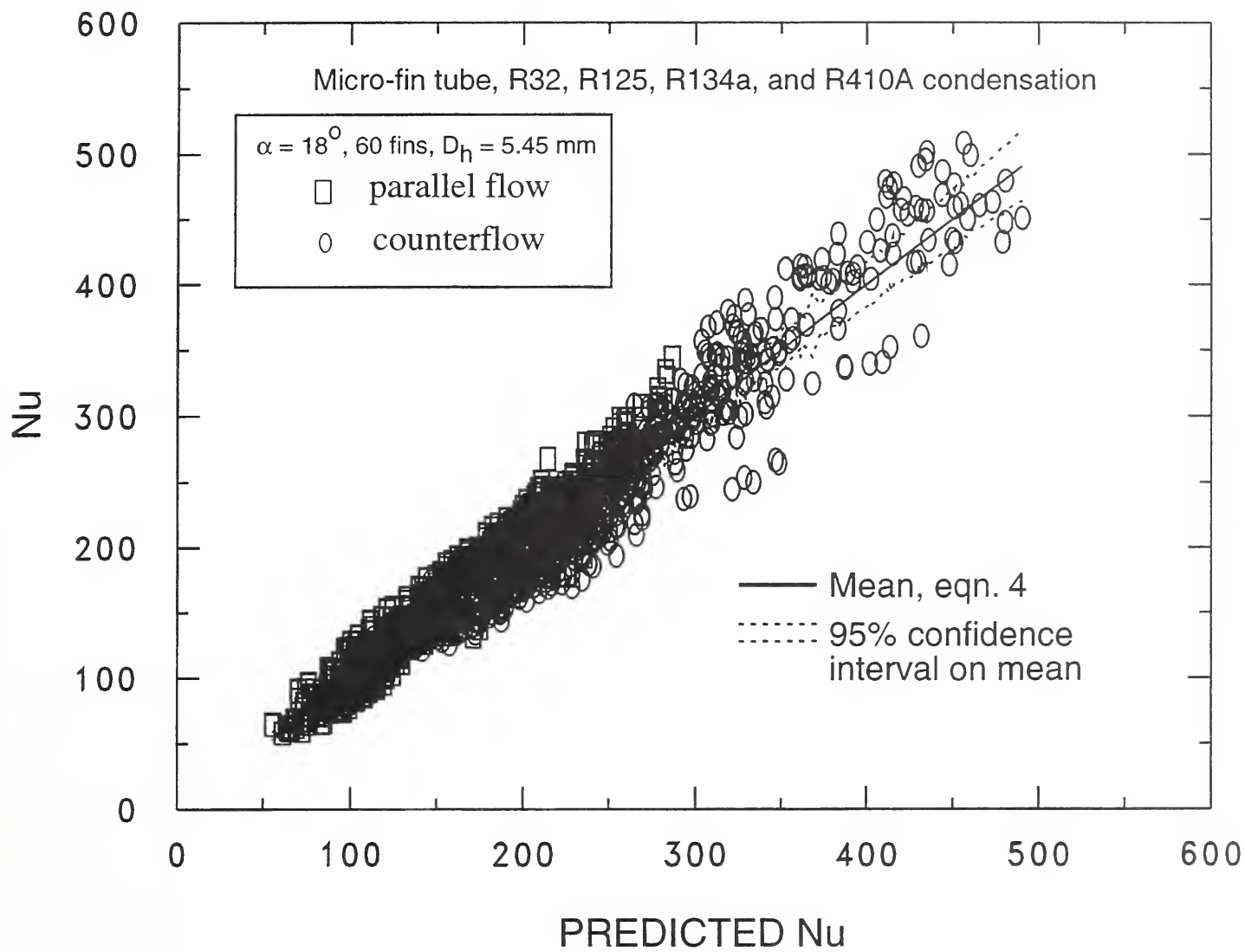


Fig. 13 Comparison of measured and predicted convective condensation Nusselt numbers

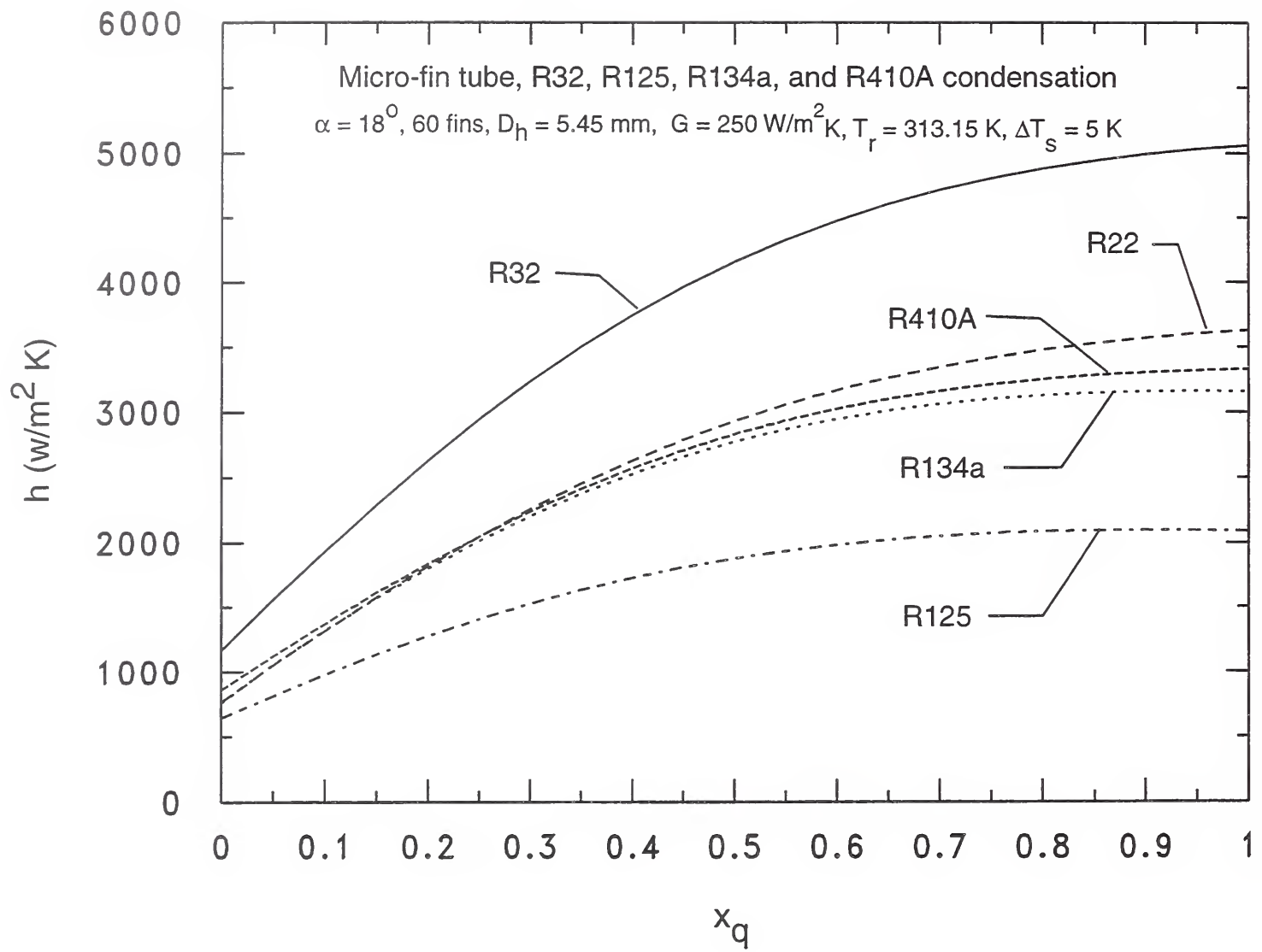


Fig. 14 Comparison of the heat-transfer coefficient for different fluids versus thermodynamic quality

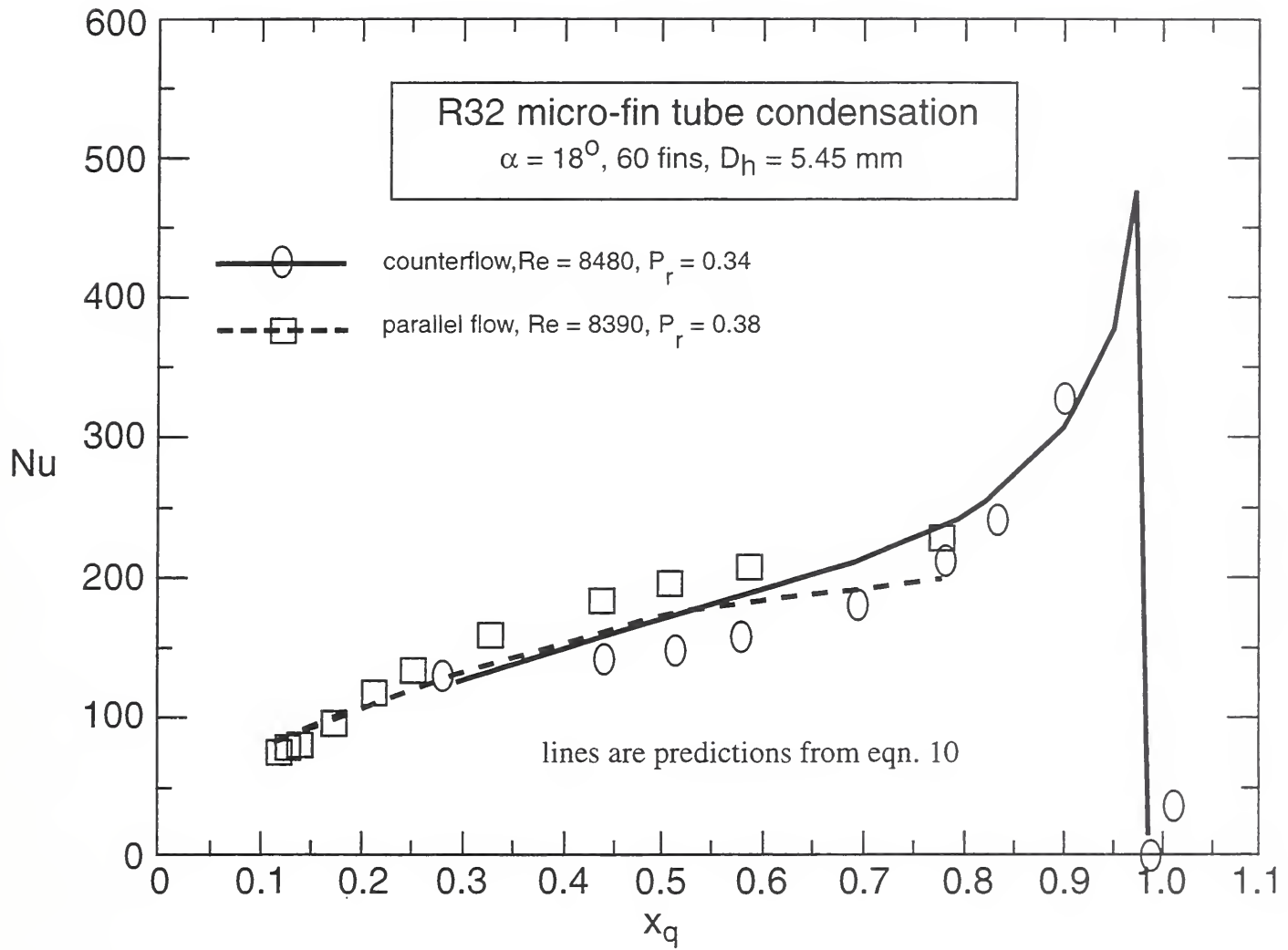


Fig. 15 Condensation Nusselt numbers versus thermodynamic quality for R32

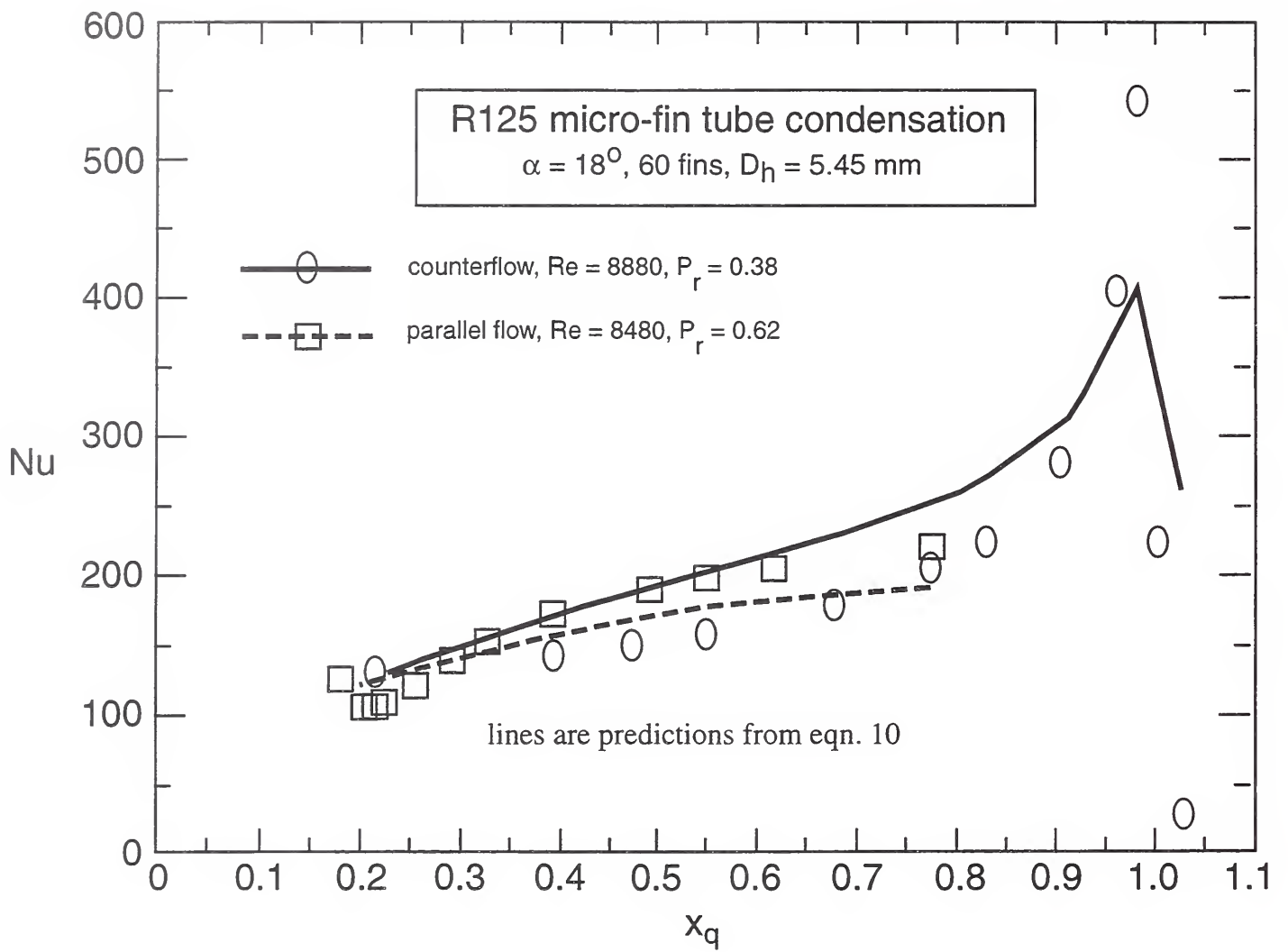


Fig 16 Condensation Nusselt numbers versus thermodynamic quality for R125

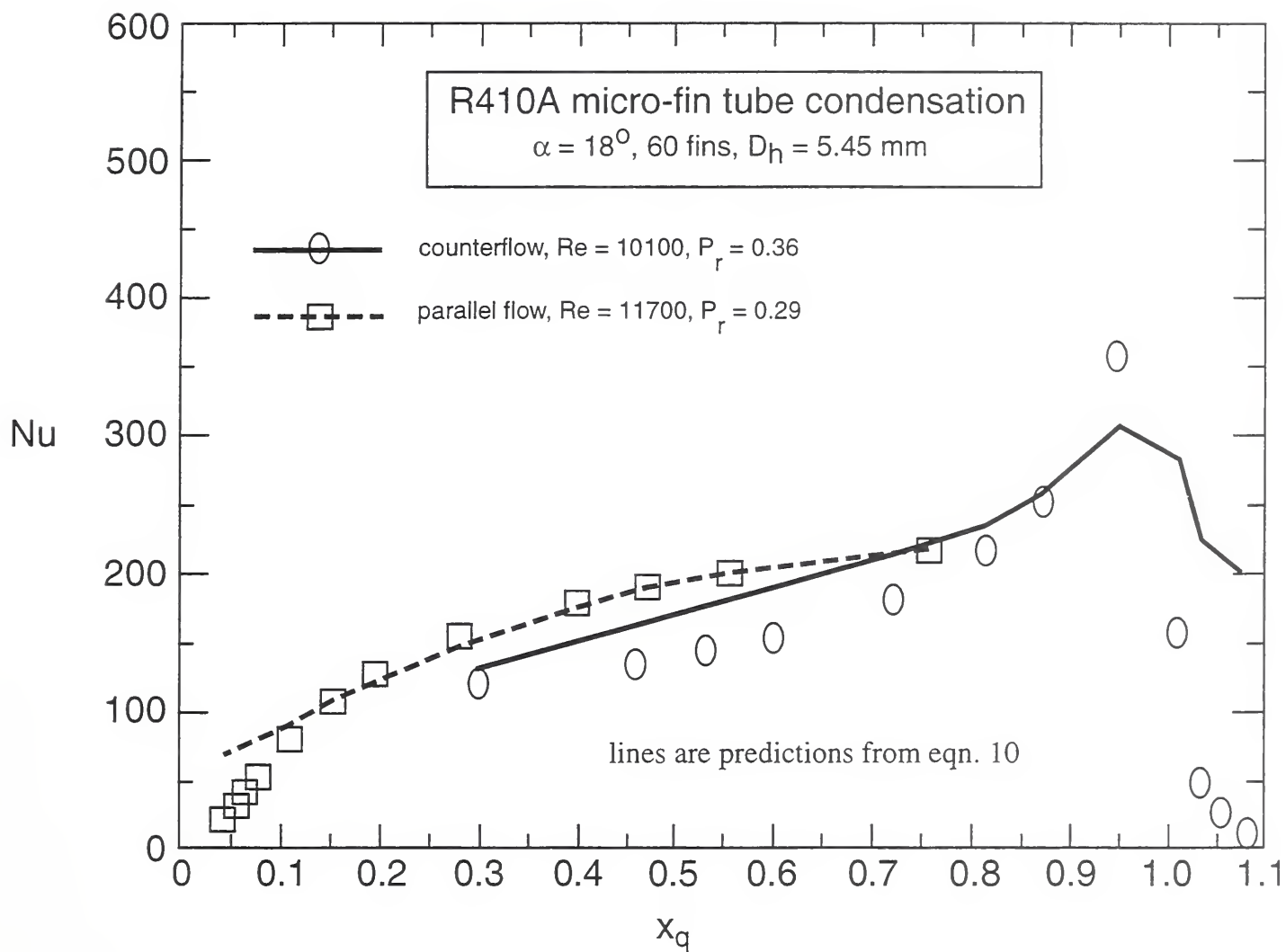


Fig. 17 Condensation Nusselt numbers versus thermodynamic quality for R410A

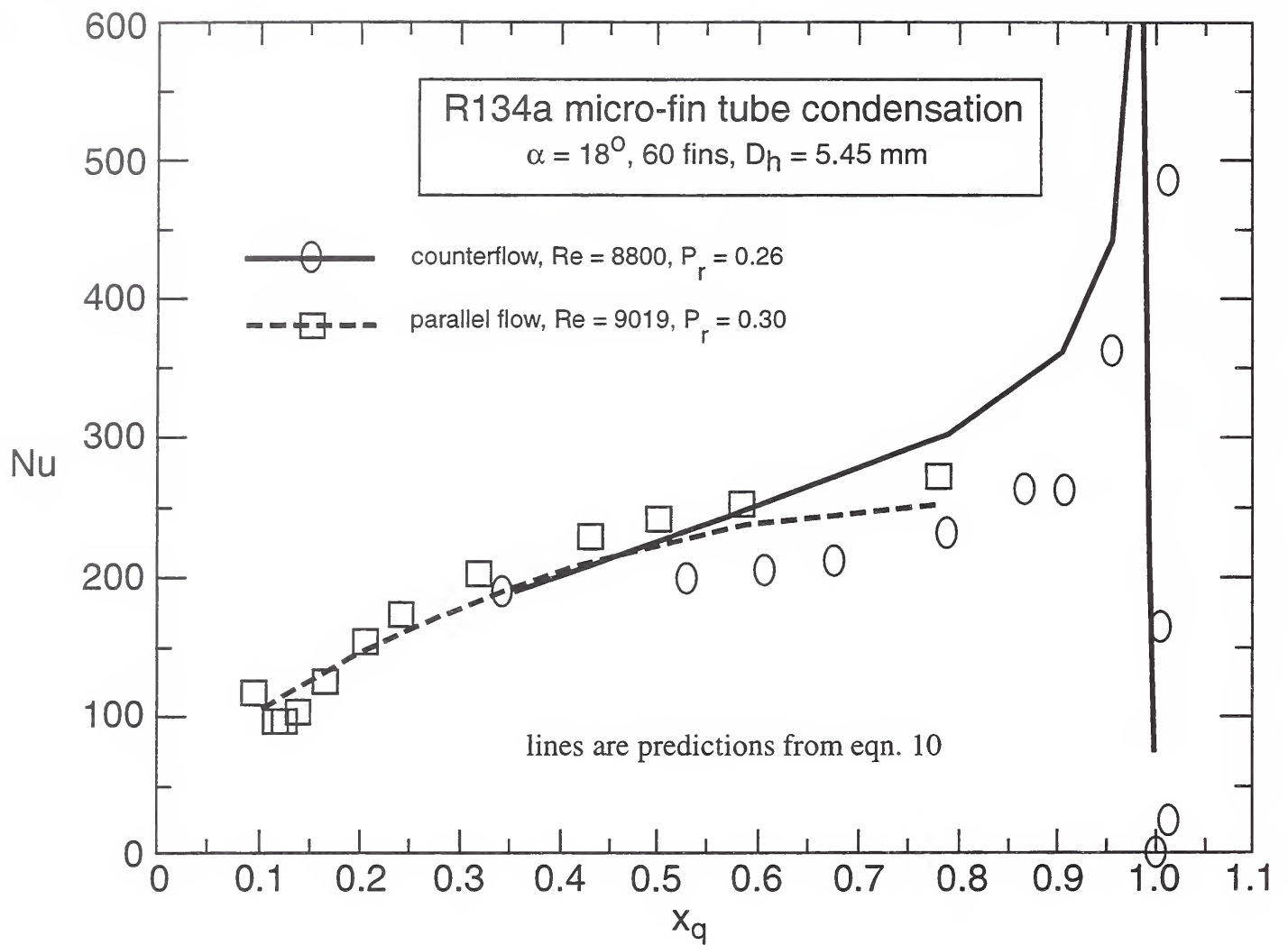


Fig. 18 Condensation Nusselt numbers versus thermodynamic quality for R134a

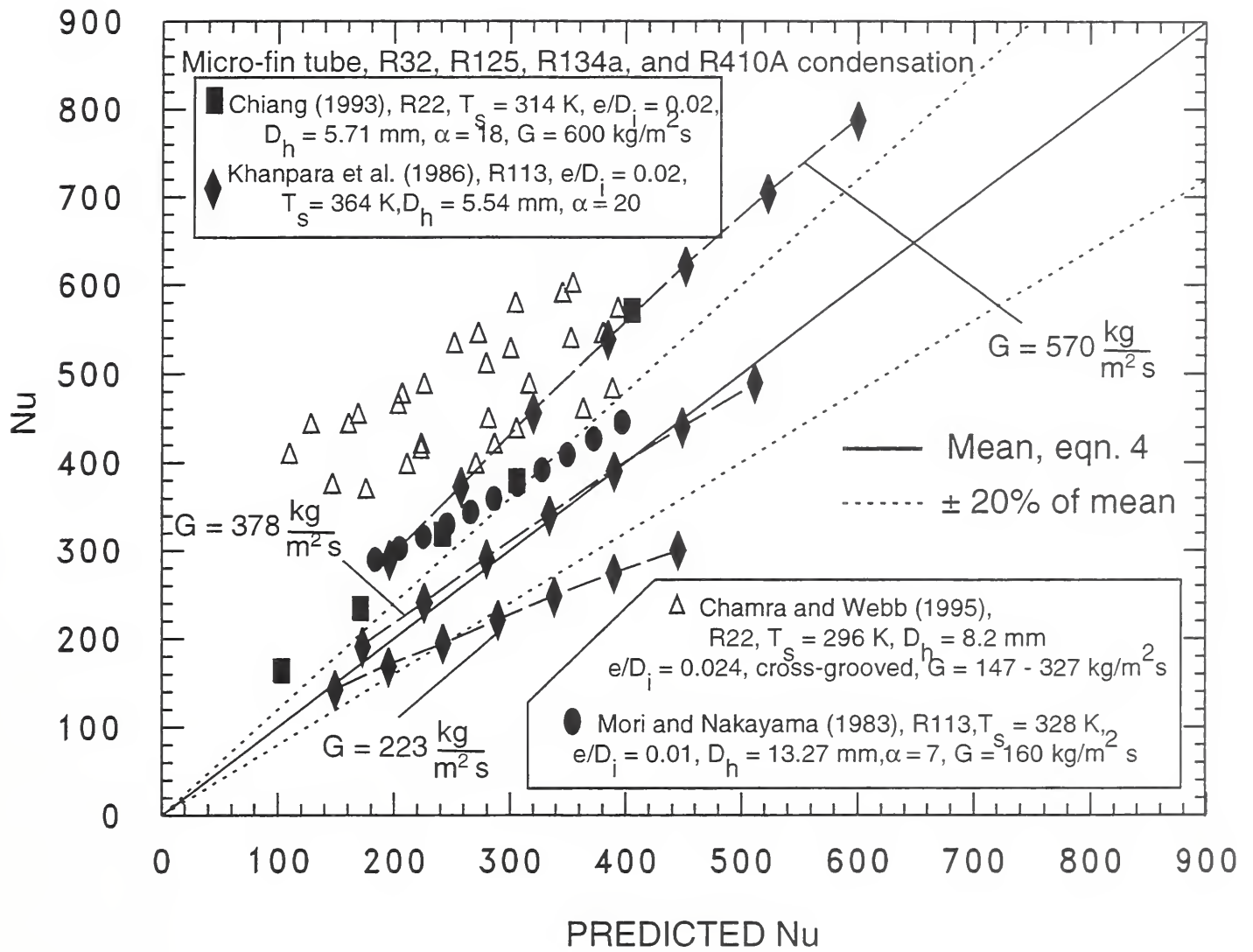


Fig. 19 Comparison of eqn. 10 to data available in the literature

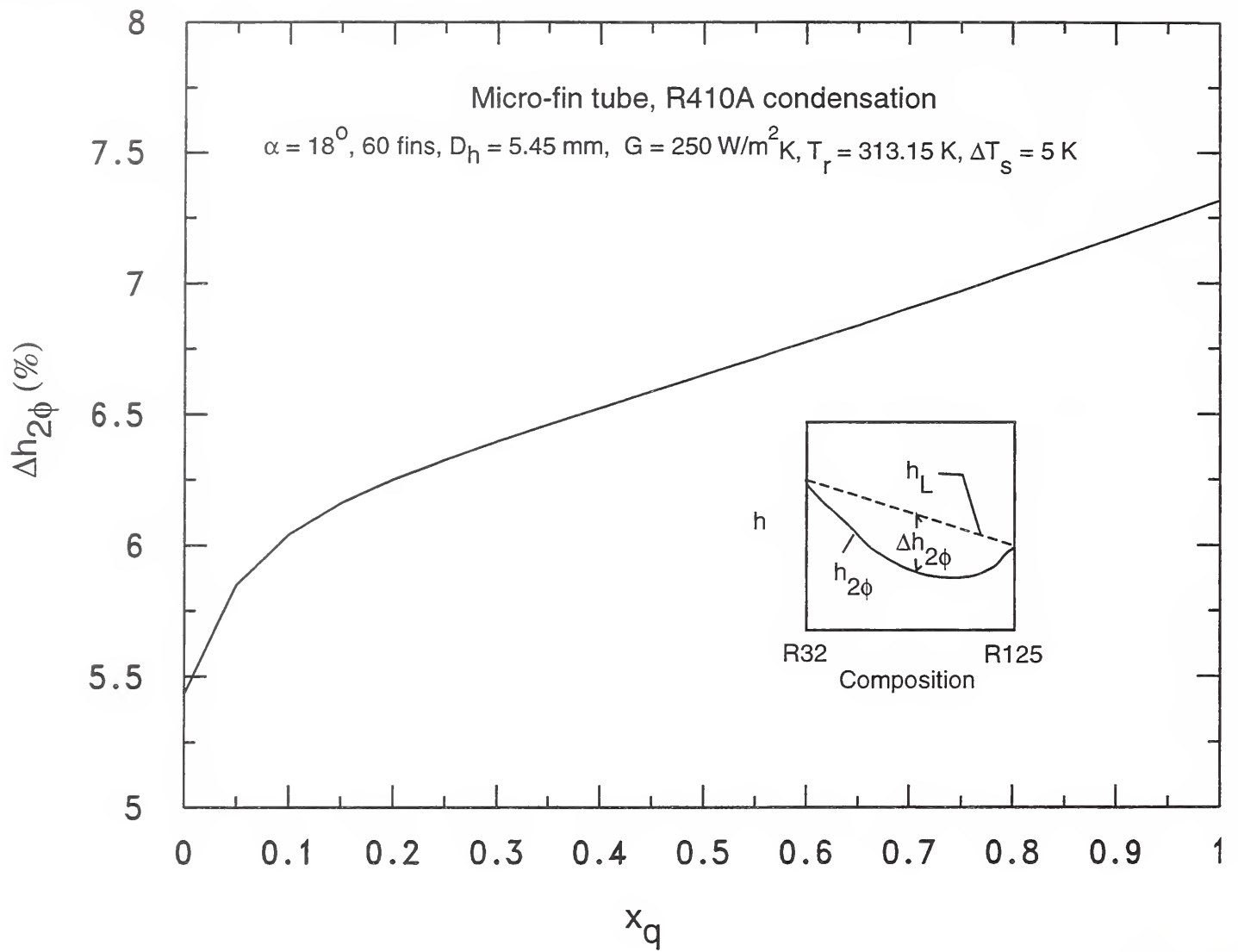


Fig. 20 Heat transfer degradation for the R410A mixture

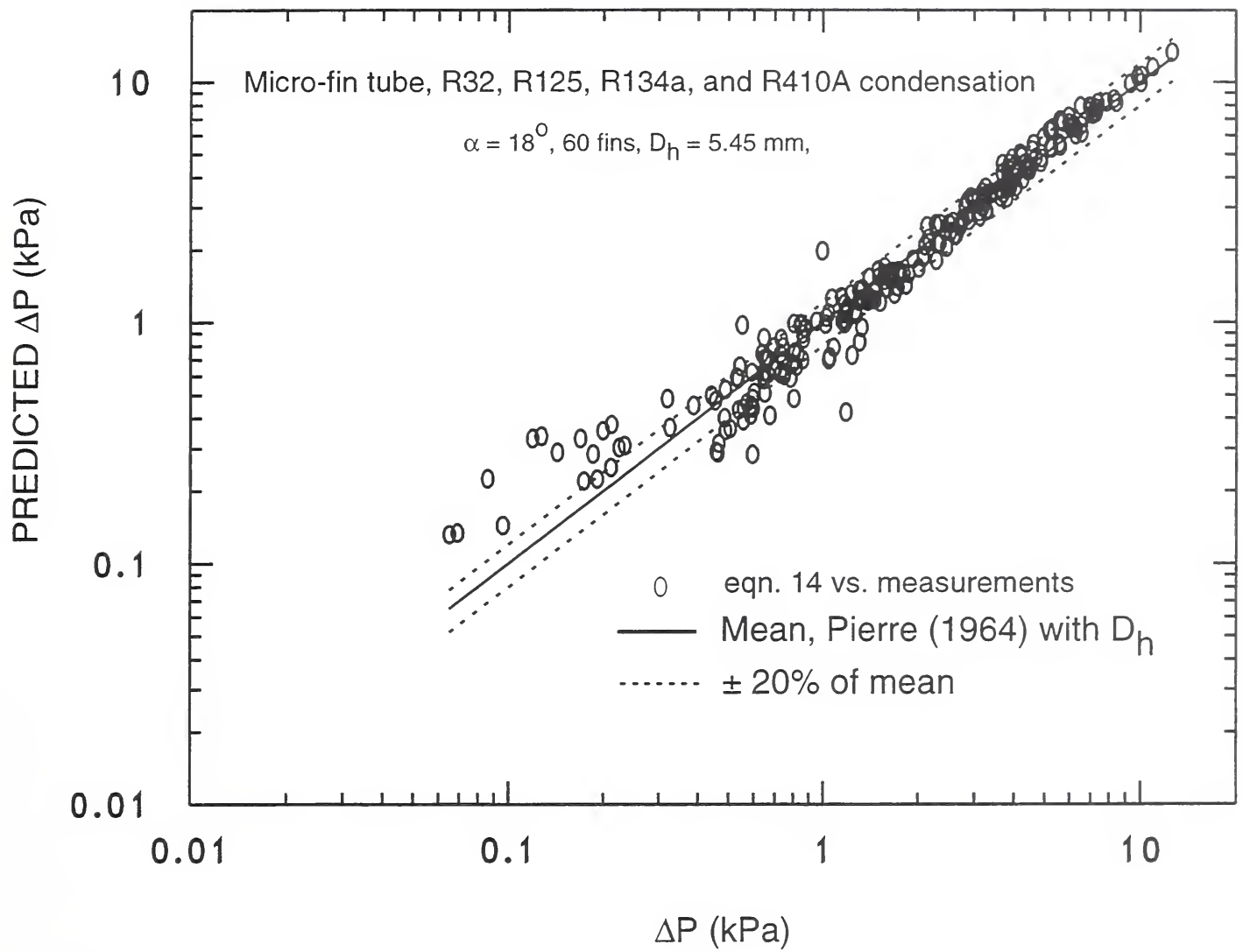


Fig. 21 Comparison of micro-fin condensation pressure drop to Pierre (1964) boiling pressure drop correlation

APPENDIX A
CONVECTIVE CONDENSATION PRESSURE DROP DATA
WITHIN A MICRO-FIN TUBE

APPENDIX A1

R32 convective condensation pressure drop data within a micro-fin tube

(file: tapres.tbl)

ΔP (Pa)	ΔL (m)	x_{qi}	x_{qo}	\dot{m}_r (kg/s)	T_n (°C)	T_{ro} (°C)	f	M (g/mole)	
551.	1.587	0.485	0.233	0.01033	296.30	296.30	0.00483	52.02	I
1180.	1.588	0.214	0.119	0.01033	296.30	296.30	0.01603	52.02	I
1184.	1.587	0.487	0.223	0.01164	299.00	299.00	0.00804	52.02	I
454.	1.588	0.204	0.107	0.01164	299.00	299.00	0.00600	52.02	I
650.	1.587	0.494	0.232	0.00836	305.40	305.30	0.00958	52.02	I
86.	1.588	0.213	0.112	0.00836	305.30	305.30	0.00287	52.02	I
753.	1.587	0.505	0.244	0.00957	308.60	308.60	0.00898	52.02	I
143.	1.588	0.225	0.131	0.00957	308.60	308.60	0.00334	52.02	I
1927.	1.587	0.488	0.211	0.01632	304.50	304.40	0.00785	52.02	I
729.	1.588	0.191	0.087	0.01632	304.40	304.40	0.00604	52.02	I
2165.	1.587	0.505	0.230	0.01867	309.80	309.80	0.00737	52.02	I
1324.	1.588	0.210	0.108	0.01867	309.80	309.70	0.00798	52.02	I
1638.	1.587	0.482	0.212	0.01414	301.20	301.20	0.00817	52.02	I
666.	1.588	0.192	0.091	0.01414	301.20	301.20	0.00667	52.02	I
1513.	1.587	0.974	0.823	0.00886	306.80	306.70	0.00846	52.02	I
805.	1.588	0.798	0.509	0.00886	306.70	306.70	0.00651	52.02	I
1168.	1.587	0.965	0.820	0.00887	306.70	306.60	0.00660	52.02	I
1166.	1.588	0.795	0.513	0.00887	306.60	306.60	0.00908	52.02	I
1659.	1.587	0.985	0.828	0.01054	309.90	309.90	0.00717	52.02	I
1063.	1.588	0.802	0.504	0.01054	309.90	309.90	0.00664	52.02	I
2132.	1.587	0.975	0.815	0.01114	297.80	297.80	0.00596	52.02	I
994.	1.588	0.788	0.490	0.01114	297.80	297.70	0.00435	52.02	I
1563.	1.587	0.972	0.821	0.01005	303.60	303.50	0.00629	52.02	I
1331.	1.588	0.795	0.508	0.01005	303.50	303.50	0.00756	52.02	I
595.	1.587	0.963	0.808	0.00538	304.80	304.80	0.00868	52.02	I
239.	1.588	0.783	0.495	0.00538	304.80	304.80	0.00526	52.02	HL
488.	1.587	0.952	0.786	0.00489	308.60	308.60	0.00975	52.02	I
120.	1.588	0.759	0.477	0.00489	308.60	308.60	0.00387	52.02	HC
576.	1.587	0.963	0.810	0.00555	307.90	307.90	0.00860	52.02	I
212.	1.588	0.784	0.497	0.00555	307.90	307.80	0.00481	52.02	I
556.	1.587	0.961	0.806	0.00560	310.10	310.10	0.00874	52.02	I
199.	1.588	0.780	0.499	0.00560	310.10	310.10	0.00472	52.02	I
1183.	1.588	0.778	0.483	0.00761	295.30	295.20	0.00943	52.02	I
1320.	1.588	0.772	0.475	0.00604	296.10	296.00	0.01664	52.02	HC
5207.	1.587	1.004	0.834	0.02038	308.00	307.00	0.00555	52.02	I
4373.	1.588	0.807	0.510	0.02038	306.90	306.80	0.00667	52.02	I
3181.	1.587	0.987	0.793	0.01532	307.90	307.90	0.00636	52.02	I
2521.	1.588	0.762	0.436	0.01532	307.80	307.80	0.00764	52.02	I
2854.	1.587	0.987	0.826	0.01473	307.70	307.70	0.00599	52.02	I
2341.	1.588	0.800	0.520	0.01473	307.60	307.60	0.00689	52.02	I
2996.	1.587	0.989	0.821	0.01531	309.60	309.50	0.00616	52.02	I
2498.	1.588	0.794	0.497	0.01531	309.50	309.50	0.00733	52.02	I
3831.	1.587	0.988	0.803	0.01553	301.60	301.50	0.00616	52.02	I
3269.	1.588	0.774	0.461	0.01553	301.40	301.30	0.00778	52.02	I
3990.	1.587	0.988	0.816	0.01710	306.60	306.50	0.00606	52.02	I
3390.	1.588	0.789	0.489	0.01710	306.50	306.40	0.00741	52.02	I
4351.	1.587	0.948	0.786	0.01635	301.30	301.10	0.00639	52.02	I
3779.	1.588	0.760	0.476	0.01635	301.10	301.00	0.00793	52.02	I
1016.	1.587	0.961	0.783	0.00731	301.50	301.50	0.00749	52.02	I
638.	1.588	0.755	0.455	0.00731	301.50	301.50	0.00709	52.02	I
1295.	1.587	0.958	0.752	0.00842	300.10	300.10	0.00711	52.02	I
872.	1.588	0.720	0.393	0.00842	300.10	300.00	0.00764	52.02	I
864.	1.587	0.966	0.797	0.00668	300.60	300.60	0.00732	52.02	I
542.	1.588	0.770	0.475	0.00668	300.60	300.60	0.00681	52.02	I
1371.	1.587	0.486	0.212	0.01255	299.80	299.80	0.00831	52.02	I
441.	1.588	0.192	0.089	0.01255	299.80	299.80	0.00564	52.02	I
1146.	1.587	0.502	0.237	0.01192	305.90	305.80	0.00842	52.02	I
387.	1.588	0.217	0.114	0.01192	305.80	305.80	0.00541	52.02	I
1392.	1.587	0.489	0.218	0.01290	301.10	301.10	0.00818	52.02	I
488.	1.588	0.198	0.096	0.01290	301.10	301.10	0.00582	52.02	I
1270.	1.587	0.540	0.312	0.01205	308.70	308.60	0.00843	52.02	I
530.	1.588	0.295	0.207	0.01205	308.60	308.60	0.00536	52.02	I
602.	1.587	0.431	0.150	0.00828	296.50	296.50	0.00919	52.02	I
505.	1.587	0.468	0.202	0.00667	299.00	299.00	0.01065	52.02	I
96.	1.588	0.183	0.088	0.00667	299.00	299.00	0.00455	52.02	I
537.	1.587	0.475	0.212	0.00745	301.20	301.20	0.00949	52.02	I
61.	1.588	0.194	0.107	0.00745	301.20	301.20	0.00253	52.02	HI
465.	1.587	0.467	0.206	0.00671	304.60	304.60	0.01104	52.02	I
69.	1.588	0.188	0.101	0.00671	304.60	304.60	0.00353	52.02	I
457.	1.587	0.478	0.220	0.00670	308.60	308.60	0.01153	52.02	I
65.	1.588	0.202	0.115	0.00670	308.60	308.60	0.00335	52.02	I
462.	1.587	0.462	0.198	0.00658	305.90	305.90	0.01190	52.02	I
44.	1.588	0.180	0.093	0.00658	305.90	305.90	0.00274	52.02	HI

APPENDIX A2

R125 convective condensation pressure drop data within a micro-fin tube

(file: tapres.tbl)

ΔP	ΔL	x_{qi}	x_{qo}	\dot{m}_r	T_{ri}	T_{ro}	f	M	
(Pa)	(m)			(kg/s)	(°C)	(°C)		(g/mole)	
1639.	1.587	1.031	0.873	0.01379	305.70	302.80	0.00615	120.00	I
1296.	1.588	0.847	0.549	0.01379	302.70	302.70	0.00681	120.00	I
1430.	1.587	1.042	0.894	0.01379	312.00	308.60	0.00624	120.00	I
1022.	1.588	0.869	0.581	0.01379	308.60	308.60	0.00615	120.00	I
2454.	1.587	0.942	0.741	0.01818	307.00	307.00	0.00683	120.00	I
1562.	1.588	0.711	0.420	0.01818	307.00	306.90	0.00649	120.00	I
4074.	1.587	0.962	0.757	0.02847	312.60	312.50	0.00541	120.00	I
2811.	1.588	0.727	0.412	0.02847	312.40	312.40	0.00564	120.00	I
3411.	1.587	0.957	0.757	0.02787	316.90	316.80	0.00539	120.00	I
2271.	1.588	0.727	0.418	0.02787	316.80	316.70	0.00534	120.00	I
5599.	1.587	0.942	0.714	0.02649	299.90	299.70	0.00613	120.00	I
3659.	1.588	0.680	0.347	0.02649	299.60	299.40	0.00658	120.00	I
4880.	1.587	0.958	0.744	0.02702	305.00	304.80	0.00579	120.00	I
3256.	1.588	0.713	0.395	0.02702	304.80	304.60	0.00604	120.00	I
4506.	1.587	0.962	0.764	0.02726	308.00	307.80	0.00564	120.00	I
3090.	1.588	0.734	0.430	0.02726	307.70	307.60	0.00580	120.00	I
1079.	1.587	0.955	0.759	0.01180	311.10	311.10	0.00783	120.00	I
535.	1.588	0.729	0.427	0.01180	311.10	311.00	0.00588	120.00	I
556.	1.587	0.970	0.833	0.00900	315.90	315.90	0.00756	120.00	I
127.	1.588	0.810	0.558	0.00900	315.90	315.90	0.00261	120.00	I
675.	1.587	0.964	0.794	0.00955	318.10	318.00	0.00895	120.00	I
119.	1.588	0.766	0.465	0.00955	318.00	318.00	0.00267	120.00	I
1868.	1.587	0.986	0.820	0.01360	298.60	298.50	0.00673	120.00	I
1397.	1.588	0.793	0.472	0.01360	298.50	298.50	0.00739	120.00	I
3871.	1.587	0.995	0.833	0.02132	300.40	300.20	0.00592	120.00	I
3285.	1.588	0.806	0.510	0.02132	300.10	300.00	0.00707	120.00	I
3696.	1.587	0.994	0.806	0.02178	303.70	303.60	0.00611	120.00	I
2734.	1.588	0.776	0.449	0.02178	303.50	303.40	0.00676	120.00	I
2281.	1.587	0.962	0.821	0.01803	310.20	310.10	0.00661	120.00	I
1600.	1.588	0.797	0.531	0.01803	310.10	310.00	0.00630	120.00	I
2340.	1.587	1.012	0.827	0.02019	314.90	314.00	0.00598	120.00	I
1492.	1.588	0.797	0.473	0.02019	313.90	313.90	0.00564	120.00	I
2076.	1.587	1.001	0.840	0.02021	317.50	317.30	0.00585	120.00	I
1398.	1.588	0.813	0.519	0.02021	317.30	317.20	0.00549	120.00	I
1233.	1.587	0.502	0.205	0.01725	313.80	313.80	0.00965	120.00	I
169.	1.588	0.182	0.056	0.01725	313.80	313.80	0.00299	120.00	I
1048.	1.587	0.555	0.289	0.01693	318.10	318.10	0.00825	120.00	I
485.	1.588	0.267	0.140	0.01693	318.10	318.10	0.00596	120.00	I
1833.	1.587	0.515	0.244	0.02035	302.70	302.70	0.00766	120.00	I
799.	1.588	0.224	0.111	0.02035	302.60	302.60	0.00596	120.00	I
2012.	1.587	0.515	0.236	0.02110	299.00	299.00	0.00732	120.00	I
832.	1.588	0.215	0.100	0.02110	299.00	298.90	0.00573	120.00	I
1682.	1.587	0.532	0.275	0.02076	309.20	309.10	0.00745	120.00	I
742.	1.588	0.255	0.146	0.02076	309.10	309.10	0.00530	120.00	I
2640.	1.587	0.537	0.281	0.02773	309.10	309.00	0.00657	120.00	I
1458.	1.588	0.261	0.149	0.02773	309.00	309.00	0.00570	120.00	I
3268.	1.587	0.526	0.261	0.02789	300.20	300.10	0.00671	120.00	I
1724.	1.588	0.241	0.124	0.02789	300.00	300.00	0.00613	120.00	I
730.	1.587	0.478	0.207	0.01300	298.60	298.60	0.00749	120.00	I
786.	1.587	0.466	0.179	0.01336	299.90	299.90	0.00827	120.00	I
680.	1.588	0.159	0.061	0.01336	299.90	299.90	0.01351	120.00	HI
805.	1.587	0.497	0.229	0.01328	311.00	310.90	0.00966	120.00	I
714.	1.588	0.210	0.114	0.01328	310.90	310.90	0.01353	120.00	HC
595.	1.587	0.549	0.323	0.01042	318.10	318.10	0.01162	120.00	I
496.	1.588	0.307	0.217	0.01042	318.10	318.10	0.01304	120.00	HC
1446.	1.587	0.510	0.232	0.02401	315.80	315.80	0.00620	120.00	I
1041.	1.588	0.212	0.109	0.02401	315.80	315.80	0.00681	120.00	HL
1803.	1.587	0.538	0.251	0.02573	316.60	316.50	0.00650	120.00	I
1303.	1.588	0.229	0.107	0.02573	316.50	316.50	0.00736	120.00	HL

APPENDIX A3

R410A convective condensation pressure drop data within a micro-fin tube

(file: tapres.tbl)

ΔP (Pa)	ΔL (m)	x_{qi}	x_{qo}	\dot{m}_r (kg/s)	T_{ri} (°C)	T_{ro} (°C)	f	M (g/mole)	
285.	1.587	0.507	0.245	0.01858	302.00	301.90	0.00188	72.59	HI
25.	1.588	0.225	0.121	0.01858	301.90	301.90	0.00086	72.59	HI
288.	1.587	0.573	0.355	0.02750	304.50	304.40	0.00105	72.59	HI
14.	1.588	0.338	0.249	0.02750	304.40	304.40	0.00044	72.59	HI
291.	1.587	0.641	0.456	0.02744	308.80	308.70	0.00085	72.59	HI
6.	1.588	0.443	0.370	0.02744	308.70	308.70	0.00026	72.59	HI
293.	1.587	0.586	0.356	0.02209	309.50	309.50	0.00134	72.59	HI
1.	1.588	0.339	0.244	0.02209	309.50	309.40	0.00042	72.59	HI
2041.	1.587	0.530	0.268	0.01971	306.90	306.80	0.00702	72.59	I
842.	1.588	0.249	0.142	0.01971	306.80	306.80	0.00495	72.59	I
6000.	1.587	0.646	0.466	0.02695	299.40	299.20	0.00640	72.59	I
4266.	1.588	0.453	0.382	0.02695	299.10	298.90	0.00560	72.59	I
5493.	1.587	0.646	0.444	0.02767	302.20	302.00	0.00619	72.59	I
4059.	1.588	0.430	0.351	0.02767	301.90	301.80	0.00580	72.59	I
3987.	1.587	0.613	0.401	0.02253	299.60	299.50	0.00677	72.59	I
2526.	1.588	0.385	0.299	0.02253	299.40	299.30	0.00578	72.59	I
589.	1.587	0.507	0.257	0.00837	298.90	298.90	0.00920	72.59	I
173.	1.588	0.240	0.151	0.00837	298.90	298.90	0.00473	72.59	I
597.	1.587	0.535	0.282	0.00837	302.20	302.20	0.00951	72.59	I
191.	1.588	0.265	0.177	0.00837	302.20	302.10	0.00502	72.59	I
587.	1.587	0.588	0.375	0.00838	309.10	309.00	0.00945	72.59	I
211.	1.588	0.361	0.287	0.00838	309.00	309.00	0.00464	72.59	I
820.	1.587	0.556	0.321	0.01053	305.70	305.60	0.00848	72.59	I
325.	1.588	0.305	0.226	0.01053	305.60	305.60	0.00494	72.59	I
3262.	1.587	1.007	0.821	0.01607	299.70	298.30	0.00590	72.59	I
2847.	1.588	0.793	0.492	0.01607	298.20	298.10	0.00745	72.59	I
2764.	1.587	0.959	0.806	0.01648	306.90	306.80	0.00624	72.59	I
2156.	1.588	0.782	0.522	0.01648	306.80	306.70	0.00666	72.59	I
7245.	1.587	0.965	0.824	0.02640	302.30	302.10	0.00552	72.59	I
6190.	1.588	0.801	0.558	0.02640	302.00	301.80	0.00626	72.59	I
4617.	1.587	1.035	0.830	0.02052	306.50	301.60	0.00554	72.59	I
3833.	1.588	0.799	0.485	0.02052	301.50	301.30	0.00683	72.59	I
6938.	1.587	0.995	0.849	0.02781	306.00	305.80	0.00517	72.59	I
5969.	1.588	0.825	0.574	0.02781	305.70	305.50	0.00592	72.59	I
6492.	1.587	1.021	0.845	0.02847	311.50	308.90	0.00502	72.59	I
5165.	1.588	0.817	0.526	0.02847	308.80	308.60	0.00566	72.59	I
6045.	1.587	0.968	0.819	0.02289	300.00	299.70	0.00573	72.59	I
5212.	1.588	0.795	0.545	0.02289	299.60	299.40	0.00664	72.59	I
1222.	1.587	1.006	0.828	0.01002	302.60	301.60	0.00620	72.59	I
952.	1.588	0.799	0.487	0.01002	301.60	301.50	0.00709	72.59	I
1039.	1.587	1.031	0.861	0.01014	312.80	309.20	0.00617	72.59	I
646.	1.588	0.833	0.528	0.01014	309.20	309.10	0.00562	72.59	I
3678.	1.587	1.013	0.838	0.02120	312.50	310.80	0.00543	72.59	I
2931.	1.588	0.811	0.526	0.02120	310.80	310.70	0.00608	72.59	I
5597.	1.587	1.035	0.842	0.02402	308.70	303.90	0.00522	72.59	I
4571.	1.588	0.813	0.508	0.02402	303.80	303.60	0.00621	72.59	I
5295.	1.587	1.031	0.843	0.02447	311.20	307.20	0.00524	72.59	I
4227.	1.588	0.814	0.514	0.02447	307.20	307.00	0.00604	72.59	I
4958.	1.587	1.020	0.838	0.02488	312.60	310.20	0.00522	72.59	I
3868.	1.588	0.809	0.513	0.02488	310.10	310.00	0.00584	72.59	I
1378.	1.587	0.464	0.183	0.01557	300.60	300.50	0.00791	72.59	I
570.	1.588	0.163	0.064	0.01557	300.50	300.50	0.00685	72.59	I
2098.	1.587	0.512	0.253	0.01946	302.50	302.40	0.00692	72.59	I
849.	1.588	0.234	0.129	0.01946	302.40	302.30	0.00498	72.59	I
2572.	1.587	0.510	0.254	0.02279	305.20	305.10	0.00664	72.59	I
1141.	1.588	0.235	0.132	0.02279	305.10	305.00	0.00507	72.59	I

APPENDIX A4

R134a convective condensation pressure drop data within a micro-fin tube

(file: tapres.tbl)

ΔP (Pa)	ΔL (m)	x_{qi}	x_{qo}	\dot{m}_r (kg/s)	T_{ri} (°C)	T_{ro} (°C)	f	M (g/mole)											
3687.	1.587	0.999	0.900	0.01685	313.90	313.70	0.00458	102.00	I	224.	1.588	0.233	0.146	0.00971	317.50	317.50	0.00432	102.00	HL
4477.	1.588	0.880	0.604	0.01685	313.50	313.30	0.00730	102.00	I	1659.	1.587	0.468	0.187	0.01605	314.00	314.00	0.00713	102.00	I
3949.	1.587	1.002	0.890	0.01887	320.50	319.90	0.00468	102.00	I	644.	1.588	0.168	0.079	0.01605	313.90	313.90	0.00587	102.00	I
4382.	1.588	0.868	0.575	0.01887	319.80	319.60	0.00701	102.00	I	1595.	1.587	0.501	0.246	0.01418	316.10	316.10	0.00783	102.00	I
4189.	1.587	1.000	0.869	0.01918	320.10	319.80	0.00488	102.00	I	592.	1.588	0.227	0.127	0.01418	316.10	316.00	0.00545	102.00	I
4418.	1.588	0.844	0.512	0.01918	319.70	319.50	0.00734	102.00	I	4029.	1.587	0.496	0.220	0.02502	315.60	315.50	0.00680	102.00	I
5711.	1.587	1.014	0.915	0.02366	324.80	322.90	0.00456	102.00	I	1734.	1.588	0.201	0.102	0.02502	315.40	315.30	0.00575	102.00	I
6299.	1.588	0.895	0.613	0.02366	322.70	322.40	0.00664	102.00	I	3603.	1.587	0.501	0.239	0.02452	319.80	319.70	0.00672	102.00	I
5965.	1.587	1.014	0.908	0.02381	323.80	321.70	0.00458	102.00	I	1610.	1.588	0.221	0.124	0.02452	319.60	319.50	0.00542	102.00	I
6532.	1.588	0.887	0.588	0.02381	321.50	321.30	0.00677	102.00	I	4370.	1.587	0.497	0.250	0.02802	321.80	321.70	0.00647	102.00	I
7004.	1.587	0.970	0.793	0.02135	312.00	311.70	0.00562	102.00	I	2298.	1.588	0.233	0.144	0.02802	321.60	321.50	0.00562	102.00	I
6269.	1.588	0.766	0.479	0.02135	311.50	311.10	0.00722	102.00	I	4694.	1.587	0.493	0.225	0.02841	317.70	317.60	0.00647	102.00	I
7365.	1.587	0.964	0.781	0.02122	310.30	309.90	0.00576	102.00	I	2104.	1.588	0.207	0.112	0.02841	317.50	317.40	0.00541	102.00	I
6553.	1.588	0.754	0.459	0.02122	309.70	309.30	0.00747	102.00	I	5258.	1.587	0.482	0.214	0.02809	312.60	312.40	0.00670	102.00	I
9801.	1.587	1.001	0.840	0.02856	322.60	321.80	0.00555	102.00	I	2194.	1.588	0.195	0.099	0.02809	312.30	312.10	0.00554	102.00	I
8279.	1.588	0.814	0.528	0.02856	321.50	321.20	0.00654	102.00	I	2886.	1.587	0.492	0.226	0.01959	313.80	313.60	0.00739	102.00	I
4865.	1.587	0.948	0.750	0.01642	312.10	311.90	0.00686	102.00	I	1163.	1.588	0.207	0.106	0.01959	313.60	313.50	0.00590	102.00	I
3793.	1.588	0.720	0.416	0.01642	311.80	311.60	0.00817	102.00	I	3115.	1.587	0.484	0.209	0.01976	310.10	309.90	0.00743	102.00	I
3898.	1.587	0.946	0.751	0.01765	324.80	324.60	0.00676	102.00	I	1187.	1.588	0.190	0.089	0.01976	309.90	309.80	0.00605	102.00	I
2751.	1.588	0.722	0.422	0.01765	324.60	324.50	0.00724	102.00	I	2711.	1.587	0.517	0.275	0.01974	319.90	319.80	0.00713	102.00	I
3640.	1.587	0.914	0.651	0.01414	312.50	312.30	0.00769	102.00	I	1336.	1.588	0.258	0.164	0.01974	319.80	319.80	0.00577	102.00	I
2076.	1.588	0.613	0.270	0.01414	312.20	312.10	0.00810	102.00	I	2599.	1.587	0.517	0.270	0.02032	324.70	324.60	0.00731	102.00	I
1177.	1.587	0.916	0.683	0.00825	317.20	317.10	0.00806	102.00	I	1193.	1.588	0.252	0.158	0.02032	324.60	324.50	0.00554	102.00	I
646.	1.588	0.648	0.298	0.00825	317.10	317.10	0.00788	102.00	I	3189.	1.587	0.502	0.230	0.02109	315.40	315.30	0.00725	102.00	I
879.	1.587	1.024	0.930	0.00734	317.00	313.50	0.00549	102.00	HL	1328.	1.588	0.211	0.111	0.02109	315.30	315.20	0.00585	102.00	I
860.	1.588	0.911	0.636	0.00734	313.50	313.40	0.00711	102.00	HL	808.	1.587	0.481	0.208	0.00985	310.00	310.00	0.00775	102.00	I
733.	1.587	1.022	0.922	0.00689	316.40	313.10	0.00517	102.00	HL	113.	1.588	0.189	0.095	0.00985	310.00	310.00	0.00280	102.0	HC
694.	1.588	0.901	0.614	0.00689	313.10	313.00	0.00664	102.00	HL	859.	1.587	0.490	0.236	0.00976	313.60	313.60	0.00849	102.00	I
10950.	1.587	0.968	0.764	0.02666	313.90	313.40	0.00606	102.00	I	233.	1.588	0.218	0.124	0.00976	313.60	313.60	0.00453	102.00	HL
8421.	1.588	0.734	0.417	0.02666	313.10	312.60	0.00715	102.00	I	749.	1.587	0.515	0.255	0.01002	323.20	323.20	0.00844	102.00	I
12610.	1.587	0.967	0.778	0.02791	312.00	311.40	0.00596	102.00	I	185.	1.588	0.237	0.144	0.01002	323.20	323.20	0.00385	102.00	I
10060.	1.588	0.750	0.451	0.02791	311.00	310.40	0.00699	102.00	I	1762.	1.587	0.497	0.234	0.01633	320.60	320.50	0.00751	102.00	I
10100.	1.587	0.966	0.754	0.02797	319.60	319.10	0.00602	102.00	I	650.	1.588	0.216	0.127	0.01633	320.50	320.50	0.00505	102.00	I
7170.	1.588	0.723	0.393	0.02797	318.90	318.50	0.00677	102.00	I	1739.	1.587	0.496	0.233	0.01632	320.50	320.50	0.00745	102.00	I
9323.	1.587	0.974	0.791	0.02829	322.90	322.50	0.00575	102.00	I	666.	1.588	0.215	0.126	0.01632	320.40	320.40	0.00517	102.00	I
7276.	1.588	0.762	0.461	0.02829	322.30	322.00	0.00662	102.00	I										
7086.	1.587	0.995	0.810	0.02389	322.70	322.40	0.00596	102.00	I										
5564.	1.588	0.781	0.478	0.02389	322.20	322.00	0.00685	102.00	I										
7836.	1.587	0.985	0.792	0.02347	317.40	317.00	0.00600	102.00	I										
6421.	1.588	0.763	0.454	0.02347	316.80	316.50	0.00730	102.00	I										
7787.	1.587	0.970	0.782	0.02218	314.00	313.60	0.00615	102.00	I										
6475.	1.588	0.753	0.453	0.02218	313.40	313.10	0.00754	102.00	I										
3963.	1.587	0.948	0.761	0.01543	314.90	314.70	0.00678	102.00	I										
3130.	1.588	0.732	0.438	0.01543	314.60	314.40	0.00797	102.00	I										
1554.	1.587	0.984	0.869	0.00994	315.80	315.70	0.00598	102.00	I										
1467.	1.588	0.847	0.567	0.00994	315.70	315.60	0.00766	102.00	I										
1262.	1.587	0.945	0.755	0.00912	321.60	321.50	0.00747	102.00	I										
743.	1.588	0.724	0.397	0.00912	321.50	321.50	0.00702	102.00	I										
3819.	1.587	0.474	0.210	0.02482	315.10	314.90	0.00673	102.00	I										
1559.	1.588	0.192	0.104	0.02482	314.90	314.80	0.00526	102.00	I										
3826.	1.587	0.471	0.203	0.02507	315.30	315.10	0.00675	102.00	I										
1498.	1.588	0.186	0.096	0.02507	315.10	315.00	0.00522	102.00	I										
1175.	1.587	0.487	0.231	0.01338	319.60	319.60	0.00741	102.00	I										
319.	1.588	0.212	0.121	0.01338	319.60	319.50	0.00391	102.00	I										
646.	1.587	0.472	0.202	0.00993	319.20	319.20	0.00781	102.00	I										
84.	1.588	0.183	0.103	0.00993	319.20	319.20	0.00239	102.00	HC										
702.	1.587	0.492	0.250	0.00971	317.50	317.50	0.00763	102.00	I										

APPENDIX B
CONVECTIVE CONDENSATION HEAT TRANSFER DATA
WITHIN A MICRO-FIN TUBE

(file: tacond.tbl)

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1458.0	4486.	0.981	2704.00	0.348	0.868	52.02	0.96	1.74	C	8.966	764.40	O2	277.6	13310.	0.809	53.86	0.376	0.876	52.02	1.13	1.77	C	1.863	21.70	I
636.9	4485.	0.964	941.70	0.348	0.868	52.02	0.97	1.74	C	4.728	269.00	O2	246.2	13290.	0.746	42.90	0.375	0.876	52.02	1.22	1.77	C	1.652	16.80	I
434.1	4485.	0.944	532.20	0.348	0.868	52.02	0.99	1.74	C	3.595	154.40	O2	205.1	13290.	0.643	31.16	0.375	0.876	52.02	1.40	1.77	C	1.376	12.40	I
280.6	4485.	0.890	253.40	0.348	0.868	52.02	1.05	1.74	C	2.735	71.50	I	173.1	13290.	0.514	23.07	0.375	0.876	52.02	1.70	1.76	C	1.161	10.50	I
215.9	4485.	0.822	153.40	0.348	0.868	52.02	1.13	1.74	C	2.415	41.80	I	160.3	13290.	0.441	20.14	0.375	0.876	52.02	1.94	1.76	C	1.076	10.70	I
189.8	4485.	0.769	118.10	0.348	0.868	52.02	1.20	1.74	C	2.313	31.70	I	149.4	13290.	0.366	17.76	0.375	0.876	52.02	2.28	1.76	C	1.003	11.50	I
163.6	4485.	0.681	85.80	0.348	0.868	52.02	1.34	1.74	C	1.677	23.10	I	131.3	13280.	0.202	14.11	0.375	0.876	52.02	3.64	1.76	C	0.881	12.70	I
143.2	4485.	0.566	63.56	0.348	0.868	52.02	1.58	1.74	C	1.602	18.20	I	18.9	13800.	1.033	23.17	0.375	0.891	52.02	0.91	1.51	C	0.126	17.90	O2
135.2	4485.	0.500	55.50	0.348	0.868	52.02	1.77	1.74	C	1.587	16.90	I	158.3	12990.	1.008	90.88	0.375	0.879	52.02	0.93	1.78	C	0.847	42.30	O2
128.3	4484.	0.430	48.99	0.348	0.868	52.02	2.02	1.74	C	1.586	16.40	I	718.9	12770.	0.989	339.40	0.374	0.876	52.02	0.94	1.76	C	3.186	147.30	O2
116.9	4484.	0.274	38.98	0.348	0.868	52.02	2.94	1.74	C	1.445	15.80	I	521.7	12770.	0.967	207.00	0.374	0.876	52.02	0.96	1.76	C	2.548	87.10	O2
-410.2	4291.	0.999	*****	0.383	0.878	52.02	0.93	1.77	C	-3.019	409.50	O2	346.5	12760.	0.910	103.90	0.374	0.876	52.02	1.02	1.76	C	1.976	41.00	I
6792.0	4291.	0.973	*****	0.383	0.878	52.02	0.95	1.77	C	35.380	*****	O2	265.1	12760.	0.840	64.08	0.374	0.876	52.02	1.10	1.76	C	1.729	23.50	I
1013.0	4291.	0.953	1362.00	0.383	0.878	52.02	0.97	1.77	C	7.607	396.90	O2	237.2	12750.	0.786	51.05	0.373	0.876	52.02	1.16	1.76	C	1.679	18.30	I
589.4	4290.	0.930	668.50	0.383	0.878	52.02	0.99	1.77	C	5.076	196.00	O2	199.9	12740.	0.700	37.05	0.373	0.875	52.02	1.30	1.76	C	1.415	13.50	I
338.2	4290.	0.872	292.00	0.383	0.878	52.02	1.06	1.77	C	3.481	83.90	O2	170.8	12740.	0.588	27.41	0.373	0.875	52.02	1.51	1.76	C	1.209	11.30	I
245.0	4290.	0.800	171.70	0.383	0.878	52.02	1.14	1.77	C	2.931	48.10	I	159.3	12740.	0.525	23.92	0.373	0.875	52.02	1.67	1.76	C	1.128	11.20	I
208.5	4290.	0.745	130.40	0.383	0.878	52.02	1.22	1.77	C	1.987	36.30	I	149.4	12740.	0.459	21.10	0.373	0.875	52.02	1.88	1.76	C	1.058	11.70	I
173.3	4290.	0.657	94.04	0.383	0.878	52.02	1.37	1.77	C	1.791	26.20	I	133.1	12740.	0.314	16.75	0.373	0.875	52.02	2.59	1.76	C	0.942	12.60	I
146.4	4290.	0.545	69.27	0.383	0.878	52.02	1.61	1.77	C	1.652	20.40	I	22.3	14800.	1.037	20.91	0.393	0.897	52.02	0.90	1.78	C	0.138	16.30	O2
135.9	4290.	0.482	60.37	0.383	0.878	52.02	1.80	1.77	C	1.610	19.40	I	135.3	13920.	1.011	68.98	0.393	0.886	52.02	0.92	1.80	C	0.733	34.20	O2
126.9	4290.	0.416	53.22	0.383	0.878	52.02	2.04	1.77	C	1.584	19.60	I	803.5	13610.	0.991	338.50	0.393	0.881	52.02	0.94	1.78	C	3.471	153.70	O2
112.1	4290.	0.272	42.24	0.383	0.878	52.02	2.88	1.77	C	1.400	20.10	I	568.5	13610.	0.968	200.90	0.392	0.881	52.02	0.96	1.78	C	2.720	88.30	O2
78.8	4861.	1.004	260.60	0.376	0.878	52.02	0.93	1.77	C	0.686	85.70	O2	371.4	13600.	0.909	98.80	0.392	0.881	52.02	1.01	1.78	C	2.086	40.40	O2
1000.0	4819.	0.981	5000.00	0.376	0.876	52.02	0.95	1.77	C	9.999	*****	O2	283.0	13600.	0.835	60.45	0.392	0.881	52.02	1.09	1.78	C	1.823	23.30	I
985.6	4819.	0.965	1350.00	0.376	0.876	52.02	0.96	1.77	C	6.754	421.70	O2	253.1	13590.	0.779	48.03	0.391	0.881	52.02	1.17	1.78	C	1.777	18.00	I
538.1	4819.	0.944	610.70	0.376	0.876	52.02	0.98	1.77	C	4.277	186.60	O2	213.5	13580.	0.687	34.77	0.391	0.881	52.02	1.31	1.78	C	1.499	13.20	I
306.8	4819.	0.891	256.00	0.376	0.876	52.02	1.04	1.77	C	2.925	74.90	HC	182.9	13580.	0.569	25.69	0.391	0.881	52.02	1.55	1.78	C	1.284	11.00	I
226.9	4818.	0.823	148.60	0.376	0.876	52.02	1.12	1.77	C	2.505	42.50	I	170.8	13580.	0.502	22.40	0.391	0.881	52.02	1.72	1.78	C	1.199	10.80	I
196.9	4818.	0.770	112.80	0.376	0.876	52.02	1.19	1.77	C	2.377	31.90	I	160.4	13580.	0.432	19.75	0.391	0.881	52.02	1.96	1.78	C	1.126	11.10	I
167.8	4818.	0.683	80.92	0.375	0.876	52.02	1.32	1.77	C	2.318	23.10	I	143.2	13580.	0.277	15.67	0.391	0.881	52.02	2.82	1.78	C	1.006	11.80	I
145.9	4818.	0.568	59.42	0.375	0.876	52.02	1.56	1.77	C	1.639	17.90	I	19.5	13890.	1.042	16.85	0.320	0.881	52.02	0.91	1.80	C	0.137	14.60	O2
137.3	4818.	0.502	51.72	0.375	0.876	52.02	1.74	1.77	C	1.613	16.70	I	108.1	12810.	1.012	54.99	0.320	0.865	52.02	0.94	1.74	C	0.594	28.20	O2
130.2	4818.	0.432	45.55	0.375	0.876	52.02	1.98	1.77	C	1.609	16.20	I	682.0	12420.	0.990	290.20	0.320	0.858	52.02	0.95	1.72	C	2.966	134.90	O2
118.3	4818.	0.276	36.11	0.375	0.876	52.02	2.87	1.77	C	1.463	15.60	I	513.9	12410.	0.964	184.80	0.320	0.858	52.02	0.98	1.72	C	2.454	82.00	O2
85.0	5051.	1.004	252.10	0.398	0.884	52.02	0.92	1.80	C	0.742	88.90	O2	349.1	12410.	0.899	96.01	0.319	0.858	52.02	1.04	1.72	C	1.948	39.40	I
3973.0	5009.	0.980	6229.00	0.398	0.883	52.02	0.94	1.79	C	20.820	*****	O2	267.6	12410.	0.819	59.95	0.319	0.858	52.02	1.14	1.72	C	1.719	22.80	I
853.7	5009.	0.963	1073.00	0.398	0.883	52.02	0.96	1.79	C	6.076	343.00	O2	241.0	12390.	0.758	48.45	0.318	0.858	52.02	1.23	1.72	C	1.692	17.80	I
517.3	5009.	0.942	542.60	0.398	0.883	52.02	0.98	1.79	C	4.176	168.90	O2	201.3	12380.	0.660	35.21	0.318	0.858	52.02	1.39	1.72	C	1.413	13.20	I
308.4	5008.	0.888	241.00	0.398	0.883	52.02	1.03	1.79	C	2.973	73.50	HC	170.3	12380.	0.536	26.07	0.318	0.858	52.02	1.68	1.72	C	1.195	11.20	I
229.4	5008.	0.819	142.50	0.398	0.883	52.02	1.11	1.79	C	2.544	42.70	I	157.9	12380.	0.467	22.76	0.318	0.858	52.02	1.91	1.72	C	1.109	11.20	I
198.7	5008.	0.766	108.70	0.398	0.883	52.02	1.18	1.79	C	2.410	32.10	I	147.3	12370.	0.394	20.06	0.318	0.858	52.02	2.21	1.72	C	1.034	11.70	I
168.5	5008.	0.680	78.48	0.398	0.883	52.02	1.32	1.79	C	2.340	23.40	I	129.7	12370.	0.236	15.92	0.317	0.858	52.02	3.40	1.72	C	0.910	12.70	I
145.4	5008.	0.568	57.87	0.398	0.883	52.02	1.54	1.79	C	1.633	18.40	I	24.8	15980.	1.037	20.30	0.365	0.890	52.02	0.91	1.84	C	0.174	16.20	O2
136.4	5008.	0.504	50.45	0.398	0.883	52.02	1.71	1.79	C	1.601	17.70	I	147.6	14950.	1.010	69.48	0.364	0.877	52.02	0.93	1.77	C	0.742	36.40	O2
128.7	5008.	0.437	44.48	0.398	0.883	52.02	1.94	1.79	C	1.591	17.90	I	742.5	14610.	0.990	288.90	0.364	0.873	52.02	0.94	1.76	C	3.055	140.80	O2
116.0	5008.	0.287	35.32	0.398	0.883	52.02	2.73	1.79	C	1.434	18.50	I	547.2	14610.	0.966	178.90	0.364	0.873	52.02	0.97	1.76	C	2.476	84.70	O2
45.8	5712.	1.007	127.80	0.270	0.844	52.02	0.95	1.70	C	0.353	46.20	O2	367.8	14610.	0.906	90.79	0.364	0.873	52.02	1.02	1.75	C	1.947	39.30	I
-2857.0	5608.	0.983	*****	0.270	0.840	52.02	0.97	1.71	C	*****	*****	O2	282.7	14600.	0.831	56.19	0.364	0.873	52.02	1.11	1.75	C	1.714	22.60	I
1397.0	5608.	0.965	1629.00	0.270	0.840	52.02	0.99	1.71	C	7.366	521.00	O2	255.4	14580.	0.774	45.21	0.363	0.872	52.02	1.19	1.75	C	1.549	17.60	I
611.1	5608.	0.944	591.40	0.270	0.840	52.02	1.01	1.71	C	3.870	182.50	O2	215.1	14580.	0.681	32.77	0.362	0.872	52.02	1.33	1.75	C	1.305	13.00	I
317.4	5608.	0.889	226.50	0.2																					

130.2	6599.	0.398	34.82	0.307	0.854	52.02	2.21	1.71	C	1.580	12.20	I
120.4	6599.	0.325	30.82	0.307	0.854	52.02	2.63	1.71	C	1.460	12.80	I
103.9	6598.	0.169	24.62	0.307	0.854	52.02	4.46	1.71	C	1.260	13.90	I
22.5	5458.	1.013	57.17	0.312	0.862	52.02	0.94	1.73	C	0.214	23.30	O2
1054.0	5276.	0.987	1470.00	0.312	0.856	52.02	0.96	1.71	C	6.147	460.70	O2
599.3	5276.	0.967	675.00	0.312	0.856	52.02	0.98	1.71	C	4.032	203.60	O2
438.0	5276.	0.944	414.10	0.311	0.856	52.02	1.00	1.71	C	3.251	120.80	O2
293.4	5275.	0.885	209.30	0.311	0.856	52.02	1.06	1.71	C	2.544	58.60	I
225.7	5275.	0.812	129.50	0.311	0.856	52.02	1.15	1.71	C	2.251	34.90	I
198.9	5274.	0.755	101.40	0.311	0.855	52.02	1.23	1.71	C	2.169	26.90	I
169.0	5274.	0.664	74.04	0.311	0.855	52.02	1.39	1.71	C	2.119	19.70	I
145.4	5273.	0.546	55.03	0.311	0.855	52.02	1.66	1.71	C	2.183	15.80	I
135.9	5273.	0.480	48.11	0.311	0.855	52.02	1.87	1.71	C	1.582	15.00	I
127.8	5273.	0.410	42.50	0.311	0.855	52.02	2.14	1.71	C	1.487	15.00	I
114.3	5273.	0.257	33.85	0.311	0.855	52.02	3.19	1.71	C	1.331	15.10	I
231.1	9810.	0.772	27.02	0.305	0.853	52.02	1.21	1.71	P	2.031	15.50	I
208.9	9808.	0.575	31.05	0.305	0.853	52.02	1.59	1.71	P	1.836	12.50	I
197.1	9807.	0.492	33.40	0.305	0.853	52.02	1.83	1.71	P	1.732	11.90	I
185.0	9806.	0.421	35.93	0.305	0.853	52.02	2.10	1.71	P	1.626	12.20	I
159.9	9805.	0.306	41.82	0.305	0.853	52.02	2.78	1.71	P	1.405	15.10	I
134.8	9803.	0.223	48.79	0.305	0.853	52.02	3.60	1.71	P	1.185	18.80	I
119.7	9802.	0.182	54.13	0.305	0.853	52.02	4.23	1.71	P	1.052	21.00	I
99.0	9801.	0.138	62.55	0.305	0.853	52.02	5.19	1.71	P	0.870	23.70	I
81.9	9801.	0.104	73.40	0.305	0.853	52.02	6.31	1.71	P	0.719	26.90	I
77.1	9800.	0.090	79.44	0.305	0.853	52.02	6.90	1.71	P	0.678	34.80	I
76.3	9800.	0.078	85.66	0.305	0.853	52.02	7.51	1.71	P	0.670	50.10	I
89.7	9800.	0.056	98.47	0.305	0.853	52.02	9.07	1.71	P	0.788	71.30	O2
228.0	10090.	0.773	26.85	0.357	0.871	52.02	1.19	1.75	P	2.089	15.20	I
208.5	10080.	0.586	31.02	0.357	0.871	52.02	1.53	1.75	P	1.910	12.60	I
198.0	10080.	0.507	33.44	0.357	0.871	52.02	1.74	1.75	P	1.814	12.00	I
187.2	10080.	0.439	36.08	0.357	0.871	52.02	1.97	1.75	P	1.715	12.40	I
164.4	10080.	0.328	42.23	0.357	0.870	52.02	2.52	1.75	P	1.506	15.30	I
141.1	10080.	0.248	49.52	0.357	0.870	52.02	3.17	1.75	P	1.293	19.20	I
126.6	10080.	0.207	54.99	0.357	0.870	52.02	3.64	1.75	P	1.160	21.40	I
106.5	10080.	0.163	63.75	0.357	0.870	52.02	4.32	1.75	P	0.976	24.30	I
88.9	10080.	0.129	74.90	0.357	0.870	52.02	5.08	1.75	P	0.815	27.80	I
83.5	10080.	0.115	80.99	0.357	0.870	52.02	5.46	1.75	P	0.765	36.00	I
81.3	10080.	0.103	87.13	0.357	0.870	52.02	5.84	1.75	P	0.745	53.40	I
90.5	10080.	0.081	99.21	0.357	0.870	52.02	6.72	1.75	P	0.829	75.50	CU
229.0	10260.	0.772	25.74	0.316	0.857	52.02	1.20	1.72	P	1.992	15.00	I
207.7	10250.	0.577	29.68	0.316	0.857	52.02	1.58	1.72	P	1.807	12.20	I
196.3	10250.	0.495	31.97	0.316	0.857	52.02	1.81	1.72	P	1.708	11.60	I
184.6	10250.	0.425	34.45	0.316	0.857	52.02	2.07	1.72	P	1.606	11.90	I
160.0	10250.	0.310	40.23	0.316	0.857	52.02	2.72	1.72	P	1.392	14.70	I
135.4	10250.	0.228	47.07	0.316	0.857	52.02	3.50	1.72	P	1.178	18.40	I
120.3	10250.	0.187	52.26	0.316	0.857	52.02	4.09	1.72	P	1.047	20.60	I
99.7	10250.	0.144	60.49	0.316	0.857	52.02	4.97	1.72	P	0.868	23.30	I
82.5	10250.	0.110	70.98	0.316	0.857	52.02	5.98	1.72	P	0.718	26.50	I
77.7	10250.	0.097	76.76	0.316	0.857	52.02	6.50	1.72	P	0.676	34.00	I
76.7	10250.	0.085	82.61	0.316	0.857	52.02	7.04	1.72	P	0.667	48.80	I
89.6	10250.	0.062	94.33	0.316	0.857	52.02	8.38	1.72	P	0.779	69.40	O2
245.7	10580.	0.777	30.87	0.384	0.879	52.02	1.17	1.77	P	2.181	15.50	I
226.5	10580.	0.613	36.20	0.383	0.879	52.02	1.45	1.77	P	2.011	13.60	I
216.1	10580.	0.545	39.40	0.383	0.879	52.02	1.61	1.77	P	1.919	13.40	I
205.5	10580.	0.486	42.94	0.383	0.879	52.02	1.78	1.77	P	1.825	14.10	I
183.2	10570.	0.389	51.50	0.383	0.879	52.02	2.15	1.77	P	1.626	17.60	I
160.7	10570.	0.321	62.27	0.383	0.878	52.02	2.53	1.77	P	1.427	22.30	I
147.5	10570.	0.286	71.01	0.383	0.878	52.02	2.77	1.77	P	1.310	25.50	I
129.5	10570.	0.249	85.80	0.383	0.878	52.02	3.08	1.77	P	1.150	30.00	I
117.2	10570.	0.219	106.70	0.383	0.878	52.02	3.39	1.77	P	1.040	36.00	I
116.7	10570.	0.207	119.30	0.383	0.878	52.02	3.54	1.77	P	1.036	43.70	I
122.2	10570.	0.196	133.10	0.383	0.878	52.02	3.68	1.77	P	1.085	57.30	I
159.5	10570.	0.175	164.10	0.383	0.878	52.02	3.99	1.77	P	1.416	87.60	O2
202.8	6200.	0.735	35.26	0.280	0.844	52.02	1.28	1.70	P	2.308	17.80	I
184.8	6200.	0.524	41.16	0.280	0.844	52.02	1.75	1.70	P	2.567	14.80	I
174.2	6200.	0.437	44.45	0.280	0.844	52.02	2.06	1.70	P	2.419	14.30	I
162.5	6200.	0.362	47.90	0.280	0.844	52.02	2.43	1.70	P	2.257	14.90	I
135.9	6199.	0.243	55.22	0.280	0.844	52.02	3.43	1.70	P	1.887	18.00	I
106.4	6199.	0.160	62.38	0.279	0.844	52.02	4.80	1.70	P	1.477	21.70	I
86.7	6199.	0.120	66.49	0.279	0.844	52.02	5.92	1.70	P	1.204	23.50	I
60.4	6196.	0.081	72.27	0.279	0.844	52.02	7.69	1.70	P	0.839	25.70	I
35.7	6193.	0.055	76.28	0.279	0.844	52.02	9.61	1.70	P	0.496	29.20	O2
26.4	6192.	0.047	77.01	0.279	0.844	52.02	10.43	1.70	P	0.366	53.40	O2
19.7	6192.	0.041	75.91	0.279	0.844	52.02	11.14	1.70	P	0.273	107.70	O2
15.1	6193.	0.032	71.14	0.279	0.844	52.02	12.41	1.70	P	0.210	115.60	O2
208.1	5161.	0.748	47.19	0.299	0.851	52.02	1.25	1.71	P	2.597	20.50	I
189.2	5161.	0.554	54.70	0.299	0.851	52.02	1.65	1.71	P	2.810	17.80	I
178.9	5161.	0.473	59.06	0.299	0.851	52.02	1.90	1.71	P	2.019	17.50	I
168.4	5161.	0.404	63.84	0.299	0.851	52.02	2.19	1.71	P	1.933	18.40	I
145.7	5161.	0.291	74.96	0.299	0.851	52.02	2.90	1.71	P	1.673	22.30	I
122.2	5160.	0.212	88.02	0.299	0.851	52.02	3.77	1.71	P	1.403	27.50	I
106.5	5161.	0.172	96.94	0.299	0.851	52.02	4.43	1.71	P	1.223	30.50	I
85.6	5161.	0.132	111.80	0.299	0.851	52.02	5.41	1.71	P	0.983	34.40	I
66.9	5161.	0.101	129.80	0.299	0.851	52.02	6.49	1.71	P	0.768	39.20	I
60.7	5161.	0.089	139.10	0.299	0.851	52.02	7.03	1.71	P	0.697	48.00	I
57.8	5161.	0.079	148.10	0.299	0.851	52.02	7.57	1.71	P	0.664	65.60	I
64.3	5160.	0.060	164.00	0.299	0.851	52.02	8.82	1.71	P	0.738	89.00	HC
206.0	5921.	0.758	39.73	0.316	0.857	52.02	1.23	1.72	P	2.441	18.50	I

188.2	5921.	0.561	46.68	0.316	0.857	52.02	1.62	1.72	P	2.657	16.10	I
178.4	5921.	0.480	50.79	0.316	0.857	52.02	1.86	1.72	P	2.012	15.80	I
168.1	5921.	0.411	55.32	0.316	0.857	52.02	2.14	1.72	P	1.896	16.70	I
145.7	5920.	0.299	66.06	0.316	0.857	52.02	2.80	1.72	P	1.644	20.80	I
122.0	5920.	0.222	79.01	0.316	0.857	52.02	3.58	1.72	P	1.376	26.10	I
106.0	5920.	0.185	88.26	0.316	0.857	52.02	4.13	1.72	P	1.196	29.40	I
84.5	5920.	0.146	103.70	0.316	0.857	52.02	4.91	1.72	P	0.953	34.00	I
65.6	5920.	0.118	122.60	0.316	0.857	52.02	5.69	1.72	P	0.740	39.60	I
59.9	5920.	0.108	132.30	0.316	0.857	52.02	6.06	1.72	P	0.676	50.40	CU
58.2	5920.	0.099	141.60	0.316	0.857	52.02	6.41	1.72	P	0.657	68.90	CU
70.0	5920.	0.081	157.10	0.316	0.857	52.02	7.23	1.72	P	0.790	90.30	I
209.1	5586.	0.748	42.47	0.346	0.867	52.02	1.23	1.74	P	2.661	20.20	I
190.1	5586.	0.553	49.64	0.346	0.867	52.02</						

88.6	9789.	0.127	44.90	0.524	0.916	120.00	3.80	3.31	P	0.916	28.10	I
80.8	9788.	0.115	47.68	0.524	0.916	120.00	3.99	3.31	P	0.835	33.90	I
76.6	9788.	0.104	49.84	0.524	0.916	120.00	4.16	3.31	P	0.791	44.90	I
81.4	9787.	0.084	51.74	0.524	0.916	120.00	4.55	3.31	P	0.841	57.00	I
221.6	8482.	0.782	18.18	0.622	0.938	120.00	1.03	3.47	P	2.602	15.70	HC
207.0	8481.	0.621	21.51	0.622	0.938	120.00	1.24	3.47	P	2.431	15.60	I
198.9	8481.	0.554	23.50	0.622	0.938	120.00	1.35	3.47	P	2.336	16.10	I
190.5	8481.	0.496	25.73	0.622	0.937	120.00	1.46	3.47	P	2.237	17.30	I
172.2	8480.	0.401	31.08	0.622	0.937	120.00	1.70	3.47	P	2.023	21.30	I
153.0	8480.	0.332	37.71	0.622	0.937	120.00	1.92	3.47	P	1.796	26.60	I
139.9	8480.	0.298	42.60	0.622	0.937	120.00	2.06	3.47	P	1.643	30.20	I
122.9	8480.	0.261	51.06	0.621	0.937	120.00	2.23	3.47	P	1.444	35.80	I
109.3	8479.	0.230	61.98	0.621	0.937	120.00	2.39	3.47	P	1.283	42.90	I
106.4	8479.	0.218	67.86	0.621	0.937	120.00	2.46	3.47	P	1.249	50.20	I
107.6	8479.	0.207	73.63	0.621	0.937	120.00	2.53	3.47	P	1.264	62.40	I
126.4	8478.	0.186	83.71	0.621	0.937	120.00	2.68	3.47	P	1.484	81.20	I
250.1	18940.	0.800	7.48	0.589	0.931	120.00	1.03	3.40	P	2.937	9.80	HC
236.2	18940.	0.599	8.99	0.589	0.931	120.00	1.30	3.40	P	2.774	8.40	I
228.1	18930.	0.515	9.90	0.589	0.931	120.00	1.46	3.40	P	2.679	8.30	I
219.2	18930.	0.443	10.91	0.589	0.931	120.00	1.63	3.40	P	2.574	8.80	I
198.7	18930.	0.326	13.33	0.589	0.931	120.00	2.02	3.40	P	2.333	11.20	I
175.0	18930.	0.242	16.28	0.589	0.931	120.00	2.43	3.40	P	2.056	14.50	I
159.2	18920.	0.201	18.57	0.588	0.931	120.00	2.70	3.40	P	1.869	16.60	I
134.5	18920.	0.158	22.09	0.588	0.931	120.00	3.07	3.40	P	1.580	19.20	I
110.4	18920.	0.123	26.06	0.588	0.931	120.00	3.43	3.40	P	1.296	22.10	I
101.8	18920.	0.110	27.84	0.588	0.931	120.00	3.59	3.40	P	1.195	27.50	I
97.0	18920.	0.099	29.23	0.588	0.931	120.00	3.75	3.40	P	1.139	38.40	I
102.1	18920.	0.077	30.43	0.588	0.931	120.00	4.08	3.40	P	1.199	51.10	I
267.4	20510.	0.820	7.68	0.600	0.933	120.00	1.00	3.42	P	3.140	10.10	HC
252.8	20510.	0.626	9.03	0.600	0.933	120.00	1.25	3.42	P	2.968	8.50	I
244.4	20510.	0.544	9.83	0.600	0.933	120.00	1.39	3.42	P	2.870	8.30	I
235.3	20500.	0.472	10.69	0.600	0.933	120.00	1.55	3.42	P	2.764	8.70	I
214.8	20500.	0.352	12.70	0.599	0.933	120.00	1.90	3.42	P	2.523	10.80	I
191.9	20500.	0.263	15.04	0.599	0.933	120.00	2.29	3.42	P	2.253	13.40	I
177.4	20490.	0.218	16.86	0.599	0.933	120.00	2.55	3.42	P	2.083	15.10	I
153.9	20490.	0.167	19.47	0.599	0.933	120.00	2.93	3.42	P	1.807	16.90	I
129.9	20480.	0.125	22.39	0.599	0.933	120.00	3.34	3.42	P	1.525	18.90	I
120.0	20480.	0.108	23.72	0.598	0.933	120.00	3.54	3.42	P	1.409	22.80	I
112.6	20480.	0.094	24.81	0.598	0.933	120.00	3.73	3.42	P	1.322	32.40	I
107.8	20480.	0.067	26.12	0.598	0.933	120.00	4.14	3.42	P	1.266	47.00	I

APPENDIX B3

Convective condensation of R410A within a micro-fin tube

(file: tacond.tbl)

Nu	Re	x_q	Ja	P/P _c	T/T _c	M	Sv	Pr	flow	E _g	u _{Nu}	198.3	19830.	0.375	129.60	0.279	0.835	72.59	2.28	2.17	P	2.329	62.10	HC	
234.3	14240.	0.775	16.07	0.302	0.844	72.59	1.18	2.20	P	2.751	12.10	I	248.8	19810.	0.360	173.00	0.279	0.835	72.59	2.35	2.17	P	2.921	111.60	O2
217.4	14250.	0.590	18.85	0.302	0.843	72.59	1.51	2.20	P	2.553	9.90	I	305.3	21280.	0.854	18.02	0.305	0.844	72.59	1.08	2.21	P	3.585	13.20	I
208.0	14250.	0.513	20.45	0.302	0.843	72.59	1.71	2.19	P	2.442	9.40	I	288.3	21280.	0.711	21.57	0.304	0.844	72.59	1.28	2.20	P	3.386	11.10	I
198.1	14250.	0.446	22.19	0.302	0.843	72.59	1.93	2.19	P	2.326	9.80	I	279.1	21270.	0.651	23.74	0.304	0.844	72.59	1.38	2.20	P	3.278	10.80	I
176.4	14260.	0.336	26.17	0.302	0.843	72.59	2.45	2.19	P	2.071	12.10	I	269.4	21270.	0.599	26.15	0.304	0.844	72.59	1.49	2.20	P	3.164	11.50	I
152.9	14260.	0.255	30.72	0.302	0.843	72.59	3.05	2.18	P	1.796	15.10	I	248.5	21260.	0.514	32.11	0.303	0.844	72.59	1.70	2.19	P	2.919	14.70	I
136.6	14270.	0.215	33.77	0.302	0.843	72.59	3.48	2.18	P	1.604	16.70	I	226.7	21260.	0.452	39.83	0.303	0.844	72.59	1.90	2.19	P	2.662	19.10	I
114.2	14270.	0.171	38.61	0.302	0.843	72.59	4.11	2.18	P	1.342	18.40	I	224.0	21210.	0.422	48.71	0.302	0.843	72.59	2.02	2.19	P	2.630	23.30	I
92.4	14270.	0.136	43.94	0.302	0.843	72.59	4.81	2.18	P	1.085	20.30	I	205.5	21210.	0.389	61.18	0.302	0.843	72.59	2.17	2.19	P	2.413	27.90	I
83.9	14270.	0.122	46.37	0.302	0.843	72.59	5.15	2.18	P	0.985	25.30	I	191.6	21200.	0.362	79.89	0.301	0.843	72.59	2.30	2.19	P	2.250	34.80	I
78.1	14270.	0.110	48.49	0.302	0.843	72.59	5.49	2.18	P	0.917	37.50	I	190.6	21200.	0.351	91.73	0.301	0.843	72.59	2.36	2.19	P	2.238	42.60	I
76.1	14270.	0.089	51.38	0.302	0.843	72.59	6.22	2.18	P	0.894	54.00	I	196.3	21190.	0.342	104.90	0.301	0.843	72.59	2.41	2.18	P	2.305	56.60	I
277.6	21810.	0.795	14.95	0.322	0.851	72.59	1.14	2.22	P	3.260	13.10	I	240.2	21180.	0.325	134.70	0.301	0.843	72.59	2.52	2.18	P	2.821	99.00	I
260.0	21820.	0.642	17.66	0.322	0.850	72.59	1.39	2.22	P	3.053	10.60	I	280.4	16710.	0.830	20.44	0.285	0.837	72.59	1.12	2.19	P	1.693	14.00	I
250.3	21830.	0.578	19.26	0.322	0.850	72.59	1.52	2.21	P	2.940	10.20	I	262.8	16710.	0.680	24.20	0.284	0.837	72.59	1.34	2.19	P	1.586	11.70	I
240.3	21830.	0.522	21.03	0.322	0.850	72.59	1.66	2.21	P	2.822	10.60	I	253.4	16710.	0.618	26.46	0.284	0.837	72.59	1.46	2.18	P	1.529	11.40	I
218.5	21840.	0.431	25.25	0.322	0.850	72.59	1.96	2.21	P	2.566	13.40	I	243.6	16710.	0.564	28.96	0.284	0.837	72.59	1.59	2.18	P	1.471	12.00	I
195.5	21840.	0.364	30.38	0.322	0.850	72.59	2.26	2.20	P	2.295	17.10	I	223.1	16710.	0.474	35.07	0.284	0.837	72.59	1.85	2.18	P	1.347	15.10	I
179.4	21850.	0.330	34.09	0.322	0.850	72.59	2.44	2.20	P	2.107	19.10	I	202.4	16710.	0.409	42.85	0.283	0.837	72.59	2.10	2.18	P	1.222	19.40	I
158.0	21850.	0.292	40.47	0.322	0.850	72.59	2.69	2.20	P	1.855	21.70	I	195.8	16690.	0.377	50.83	0.283	0.836	72.59	2.26	2.17	P	1.182	22.80	I
138.3	21860.	0.262	48.62	0.322	0.850	72.59	2.93	2.20	P	1.624	24.80	I	178.8	16690.	0.341	62.52	0.283	0.836	72.59	2.46	2.17	P	1.079	27.00	I
131.9	21860.	0.250	53.02	0.322	0.850	72.59	3.04	2.20	P	1.549	29.70	CU	166.7	16680.	0.311	79.72	0.282	0.836	72.59	2.65	2.17	P	1.006	33.00	I
129.3	21860.	0.239	57.38	0.322	0.850	72.59	3.14	2.20	P	1.519	39.70	CU	166.1	16680.	0.299	90.55	0.282	0.836	72.59	2.74	2.17	P	1.003	40.00	I
139.5	21860.	0.219	65.27	0.322	0.850	72.59	3.35	2.20	P	1.638	62.50	I	171.3	16680.	0.289	102.60	0.282	0.836	72.59	2.82	2.17	P	1.034	53.10	I
297.1	23100.	0.830	17.28	0.359	0.863	72.59	1.08	2.27	P	3.489	13.10	I	210.0	16680.	0.270	131.30	0.282	0.836	72.59	2.98	2.17	P	1.267	91.70	I
281.2	23110.	0.699	20.72	0.359	0.862	72.59	1.26	2.26	P	3.302	11.20	I	213.2	6149.	0.776	33.46	0.279	0.835	72.59	1.19	2.19	P	2.394	15.50	I
272.2	23120.	0.645	22.79	0.359	0.862	72.59	1.35	2.26	P	3.197	11.00	I	197.4	6153.	0.590	39.94	0.279	0.835	72.59	1.53	2.18	P	2.589	14.30	I
262.8	23120.	0.597	25.11	0.359	0.862	72.59	1.45	2.26	P	3.086	11.70	I	188.8	6155.	0.513	43.84	0.279	0.835	72.59	1.73	2.18	P	2.680	14.50	I
241.8	23120.	0.520	30.75	0.359	0.862	72.59	1.63	2.25	P	2.839	14.90	I	179.9	6156.	0.447	48.22	0.279	0.835	72.59	1.95	2.17	P	2.554	15.60	I
218.6	23130.	0.464	37.83	0.359	0.862	72.59	1.80	2.25	P	2.567	19.20	I	160.7	6158.	0.341	58.90	0.279	0.835	72.59	2.46	2.17	P	2.281	19.50	I
201.6	23130.	0.435	43.03	0.359	0.862	72.59	1.89	2.25	P	2.367	21.80	I	140.6	6159.	0.267	72.50	0.279	0.835	72.59	3.02	2.17	P	1.995	25.00	I
178.6	23140.	0.405	52.16	0.359	0.862	72.59	2.01	2.25	P	2.097	25.40	CU	126.8	6161.	0.230	82.81	0.279	0.835	72.59	3.39	2.17	P	1.799	28.50	I
157.0	23140.	0.380	63.96	0.359	0.862	72.59	2.11	2.25	P	1.844	30.10	O2	108.8	6162.	0.192	101.40	0.279	0.835	72.59	3.89	2.16	P	1.544	34.10	I
150.1	23140.	0.370	70.25	0.359	0.862	72.59	2.16	2.25	P	1.763	35.50	O2	94.3	6162.	0.163	127.50	0.279	0.835	72.59	4.39	2.16	P	1.338	41.90	I
147.7	23140.	0.362	76.28	0.359	0.862	72.59	2.20	2.25	P	1.735	46.00	O2	91.6	6162.	0.152	143.00	0.279	0.835	72.59	4.62	2.16	P	1.301	50.80	I
161.4	23140.	0.346	86.09	0.359	0.862	72.59	2.28	2.25	P	1.895	69.60	CU	94.0	6162.	0.142	159.40	0.279	0.835	72.59	4.84	2.16	P	1.334	65.20	I
266.1	18790.	0.821	15.35	0.366	0.865	72.59	1.09	2.28	P	3.125	12.00	I	121.2	6163.	0.123	194.10	0.279	0.835	72.59	5.35	2.16	P	1.720	94.80	O2
249.5	18800.	0.659	18.19	0.366	0.864	72.59	1.32	2.27	P	2.930	10.00	I	222.0	6434.	0.808	32.42	0.304	0.844	72.59	1.13	2.21	P	2.451	15.70	I
240.4	18810.	0.591	19.88	0.366	0.864	72.59	1.45	2.27	P	2.823	9.70	I	205.2	6439.	0.618	38.76	0.304	0.844	72.59	1.45	2.20	P	2.625	14.50	I
231.0	18810.	0.532	21.75	0.366	0.864	72.59	1.59	2.26	P	2.713	10.20	I	196.1	6440.	0.540	42.58	0.304	0.844	72.59	1.63	2.20	P	2.709	14.80	I
210.7	18810.	0.436	26.22	0.365	0.864	72.59	1.88	2.26	P	2.474	12.90	I	186.7	6442.	0.473	46.89	0.304	0.844	72.59	1.83	2.19	P	2.579	15.80	I
189.2	18820.	0.365	31.71	0.365	0.864	72.59	2.17	2.26	P	2.222	16.40	I	166.5	6444.	0.366	57.46	0.304	0.844	72.59	2.28	2.19	P	2.300	19.90	I
174.4	18820.	0.330	35.70	0.366	0.864	72.59	2.35	2.25	P	2.048	18.50	I	145.5	6445.	0.292	71.07	0.304	0.844	72.59	2.74	2.19	P	2.011	25.50	I
155.1	18830.	0.290	42.62	0.366	0.864	72.59	2.59	2.25	P	1.822	21.30	I	131.3	6446.	0.255	81.52	0.304	0.844	72.59	3.05	2.18	P	1.814	29.50	I
138.5	18830.	0.258	51.57	0.366	0.864	72.59	2.83	2.25	P	1.627	24.70	I	113.2	6447.	0.218	100.80	0.304	0.844	72.59	3.44	2.18	P	1.564	35.60	I
134.0	18830.	0.245	56.45	0.366	0.864	72.59	2.94	2.25	P	1.574	29.70	I	99.9	6448.	0.189	128.80	0.304	0.844	72.59	3.82	2.18	P	1.380	44.20	I
129.3	18830.	0.233	61.26	0.366	0.864	72.59	3.04	2.25	P	1.569	40.00	I	98.8	6448.	0.177	145.90	0.304	0.844	72.59	4.00	2.18	P	1.366	53.70	I
149.0	18830.	0.211	70.07	0.366	0.864	72.59	3.26	2.25	P	1.750	60.40	I	104.1	6448.	0.167	165.00	0.304	0.844	72.59	4.17	2.18	P	1.438	69.20	I
244.7	16170.	0.796	14.62	0.343	0.857	72.59	1.13	2.24	P	2.874	11.70	I	143.5	6448.	0.147	208.10	0.304	0.844	72.59	4.54	2.18	P	1.982	104.10	O2
229.3	16180.	0.612	17.30	0.343	0.857	72.59	1.43	2.24	P	2.693	9.60	I	240.0	7088.	0.819	36.65	0.362	0.863	72.59	1					

117.9	8504.	0.217	154.40	0.332	0.854	72.59	3.33	2.21	P	1.154	68.90	I
162.6	8505.	0.199	187.50	0.332	0.854	72.59	3.55	2.21	P	1.591	101.00	O2
16.3	13580.	1.064	11.94	0.275	0.860	72.59	0.89	2.30	C	0.159	11.70	O2
53.5	12580.	1.032	23.06	0.275	0.847	72.59	0.92	2.23	C	0.316	13.50	O2
168.3	11940.	1.009	61.80	0.275	0.837	72.59	0.93	2.20	C	0.897	27.30	O2
473.7	11700.	0.983	144.10	0.275	0.833	72.59	0.96	2.19	C	2.305	61.70	O2
346.7	11700.	0.917	81.55	0.275	0.833	72.59	1.02	2.19	C	1.943	32.90	I
272.5	11700.	0.837	52.89	0.274	0.833	72.59	1.11	2.19	C	1.743	20.00	I
247.0	11680.	0.777	43.34	0.274	0.833	72.59	1.19	2.19	C	1.715	15.90	I
206.8	11690.	0.682	31.98	0.273	0.833	72.59	1.34	2.18	C	1.436	11.90	I
174.4	11690.	0.563	23.94	0.273	0.833	72.59	1.60	2.18	C	1.211	10.00	I
161.2	11690.	0.497	20.99	0.273	0.833	72.59	1.79	2.17	C	1.120	9.90	I
149.7	11690.	0.429	18.56	0.273	0.833	72.59	2.03	2.17	C	1.039	10.30	I
130.4	11700.	0.283	14.81	0.273	0.833	72.59	2.90	2.16	C	0.906	11.20	I
220.4	13580.	1.003	199.50	0.342	0.858	72.59	0.92	2.26	C	0.977	88.10	O2
535.0	13500.	0.978	249.40	0.342	0.857	72.59	0.94	2.25	C	2.363	110.60	O2
467.1	13500.	0.961	176.40	0.342	0.857	72.59	0.95	2.25	C	2.214	77.40	O2
412.1	13500.	0.939	131.10	0.342	0.857	72.59	0.97	2.25	C	2.083	55.70	HC
328.1	13500.	0.886	79.35	0.342	0.857	72.59	1.03	2.25	C	1.875	32.20	I
271.1	13500.	0.819	53.17	0.342	0.857	72.59	1.10	2.24	C	1.746	20.50	I
249.6	13490.	0.769	43.75	0.341	0.857	72.59	1.17	2.24	C	1.608	16.50	I
215.6	13490.	0.688	32.77	0.341	0.857	72.59	1.29	2.24	C	1.389	12.50	I
187.1	13490.	0.584	24.80	0.341	0.857	72.59	1.49	2.23	C	1.205	10.30	I
175.3	13490.	0.527	21.83	0.341	0.857	72.59	1.63	2.23	C	1.129	10.00	I
164.9	13490.	0.466	19.40	0.341	0.857	72.59	1.81	2.23	C	1.063	10.30	I
147.4	13500.	0.334	15.59	0.341	0.856	72.59	2.38	2.22	C	0.949	10.80	I
129.8	20580.	1.006	85.14	0.305	0.847	72.59	0.93	2.22	C	0.836	43.80	O2
434.8	20310.	0.984	147.70	0.305	0.845	72.59	0.95	2.22	C	2.801	75.30	I
423.5	20300.	0.967	116.50	0.305	0.844	72.59	0.96	2.21	C	2.728	57.30	I
402.1	20290.	0.947	93.13	0.304	0.844	72.59	0.98	2.21	C	2.591	44.40	I
349.2	20280.	0.897	61.41	0.304	0.844	72.59	1.03	2.21	C	2.250	27.20	I
301.6	20270.	0.836	42.95	0.304	0.844	72.59	1.10	2.21	C	1.943	17.80	I
294.8	20210.	0.789	37.61	0.302	0.843	72.59	1.16	2.20	C	1.899	15.10	I
256.2	20200.	0.713	28.31	0.301	0.843	72.59	1.27	2.20	C	1.651	11.40	I
223.3	20190.	0.617	21.49	0.301	0.843	72.59	1.45	2.20	C	1.439	9.70	I
209.6	20190.	0.563	18.94	0.301	0.843	72.59	1.58	2.19	C	1.350	9.60	I
197.3	20190.	0.506	16.81	0.301	0.843	72.59	1.73	2.19	C	1.271	9.90	I
176.5	20190.	0.382	13.50	0.300	0.843	72.59	2.20	2.19	C	1.137	10.40	I
17.1	19820.	1.099	7.12	0.300	0.882	72.59	0.86	2.50	C	0.110	11.90	O2
44.0	18000.	1.063	11.53	0.300	0.868	72.59	0.89	2.33	C	0.284	11.50	O2
80.6	16940.	1.037	18.56	0.300	0.857	72.59	0.91	2.27	C	0.519	12.50	O2
256.7	15870.	1.007	53.64	0.300	0.845	72.59	0.93	2.22	C	1.654	26.40	O2
364.3	15630.	0.934	58.05	0.299	0.843	72.59	0.99	2.21	C	1.821	27.10	I
293.4	15630.	0.847	39.20	0.299	0.842	72.59	1.09	2.20	C	1.670	17.00	I
268.0	15600.	0.783	32.77	0.298	0.842	72.59	1.17	2.20	C	1.525	13.80	I
224.2	15600.	0.682	24.54	0.298	0.842	72.59	1.33	2.20	C	1.276	10.40	I
187.6	15600.	0.558	18.57	0.298	0.842	72.59	1.59	2.19	C	1.067	9.10	I
172.4	15600.	0.490	16.34	0.297	0.842	72.59	1.78	2.19	C	0.981	9.40	I
159.1	15600.	0.421	14.51	0.297	0.842	72.59	2.03	2.19	C	0.906	10.50	I
136.7	15610.	0.275	11.65	0.297	0.842	72.59	2.90	2.18	C	0.778	12.10	I
37.6	24290.	1.038	20.13	0.335	0.868	72.59	0.90	2.32	C	0.214	16.40	O2
144.6	23130.	1.014	43.32	0.335	0.860	72.59	0.91	2.27	C	0.823	25.20	O2
473.9	22500.	0.997	112.80	0.335	0.855	72.59	0.92	2.24	C	2.697	61.30	HC
441.0	22490.	0.976	88.30	0.334	0.855	72.59	0.94	2.24	C	2.510	46.30	I
373.7	22480.	0.925	56.73	0.334	0.855	72.59	0.99	2.24	C	2.126	27.60	I
318.8	22470.	0.861	39.14	0.334	0.854	72.59	1.06	2.24	C	1.814	17.70	I
307.6	22410.	0.813	33.82	0.332	0.854	72.59	1.12	2.23	C	1.751	14.80	I
266.9	22400.	0.734	25.37	0.331	0.854	72.59	1.22	2.23	C	1.519	11.20	I
232.4	22390.	0.634	19.22	0.331	0.853	72.59	1.39	2.22	C	1.323	9.60	I
218.1	22390.	0.578	16.92	0.331	0.853	72.59	1.51	2.22	C	1.241	9.60	I
205.4	22390.	0.519	15.02	0.331	0.853	72.59	1.66	2.22	C	1.169	10.10	I
183.9	22390.	0.391	12.06	0.330	0.853	72.59	2.11	2.21	C	1.046	10.90	I
28.8	27960.	1.073	10.20	0.362	0.888	72.59	0.86	2.52	C	0.164	15.10	O2
78.5	26180.	1.044	16.51	0.361	0.878	72.59	0.88	2.39	C	0.447	15.60	O2
152.1	25070.	1.023	27.39	0.361	0.871	72.59	0.90	2.33	C	0.866	19.50	O2
477.4	24030.	0.997	72.63	0.361	0.863	72.59	0.92	2.28	C	2.716	45.50	O2
388.1	24020.	0.935	45.35	0.361	0.863	72.59	0.97	2.27	C	2.209	26.30	I
322.4	24010.	0.859	30.86	0.360	0.863	72.59	1.05	2.27	C	1.835	16.60	I
301.8	23950.	0.802	26.06	0.359	0.862	72.59	1.12	2.26	C	1.717	13.50	I
258.6	23950.	0.711	19.54	0.358	0.862	72.59	1.24	2.26	C	1.472	10.20	I
222.4	23940.	0.595	14.80	0.358	0.862	72.59	1.45	2.26	C	1.266	9.00	I
207.4	23940.	0.531	13.03	0.358	0.862	72.59	1.60	2.25	C	1.180	9.30	I
194.2	23940.	0.465	11.58	0.358	0.862	72.59	1.79	2.25	C	1.105	10.30	I
171.7	23950.	0.320	9.30	0.357	0.862	72.59	2.42	2.24	C	0.977	11.60	I
77.7	17470.	1.012	56.30	0.287	0.843	72.59	0.93	2.21	C	0.442	28.30	O2
459.1	17030.	0.987	175.20	0.286	0.838	72.59	0.95	2.20	C	2.612	84.00	I
437.5	17030.	0.970	135.60	0.286	0.838	72.59	0.96	2.20	C	2.490	62.90	I
408.8	17020.	0.949	107.10	0.286	0.838	72.59	0.98	2.20	C	2.326	48.00	I
346.9	17010.	0.896	69.52	0.286	0.838	72.59	1.04	2.20	C	1.603	29.10	I
294.8	17010.	0.831	48.20	0.285	0.837	72.59	1.11	2.19	C	1.523	18.90	I
284.3	16960.	0.783	41.81	0.284	0.837	72.59	1.18	2.19	C	1.469	15.90	I
244.9	16960.	0.704	31.39	0.283	0.837	72.59	1.30	2.19	C	1.266	12.00	I
211.6	16950.	0.605	23.79	0.283	0.836	72.59	1.49	2.18	C	1.093	10.20	I
197.7	16950.	0.549	20.95	0.283	0.836	72.59	1.62	2.18	C	1.021	10.00	I
185.3	16950.	0.492	18.59	0.283	0.836	72.59	1.79	2.18	C	0.958	10.30	I
164.4	16950.	0.366	14.92	0.283	0.836	72.59	2.31	2.17	C	0.849	10.80	I
11.1	8638.	1.056	14.44	0.299	0.865	72.59	0.89	2.31	C	0.091	18.00	O2
39.4	8099.	1.028	28.97	0.299	0.853	72.59	0.91	2.25	C	0.312	19.20	O2
155.1	7747.	1.008	95.35	0.299	0.845	72.59	0.93	2.22	C	1.065	43.30	O2
598.9	7627.	0.983	299.40	0.299	0.843	72.59	0.95	2.21	C	3.549	133.30	O2
325.8	7628.	0.921	122.30	0.299	0.842	72.59	1.01	2.21	C	2.345	50.60	I
234.5	7629.	0.843	70.49	0.299	0.842	72.59	1.09	2.20	C	1.960	27.60	I
203.0	7628.	0.784	54.07	0.299	0.842	72.59	1.17	2.20	C	1.860	20.70	I
169.2	7630.	0.688	38.67	0.299	0.842	72.59	1.32	2.20	C	1.792	14.90	I
143.9	7633.	0.563	28.36	0.299	0.842	72.59	1.58	2.19	C	1.524	12.30	I
134.1	7634.	0.493	24.68	0.299	0.842	72.59	1.77	2.19	C	1.420	12.10	I
125.8	7636.	0.419	21.74	0.299	0.842	72.59	2.04	2.19	C	1.332	12.50	I
112.1	7640.	0.257	17.24	0.299	0.842	72.59	3.05	2.18	C	1.187	13.30	I
9.2	10120.	1.079	10.04	0.363	0.890	72.59	0.86	2.56	C	0.074	20.40	O2
24.9	9518.	1.053	15.70	0.363	0.881	72.59	0.88	2.43	C	0.204	18.20	O2
47.0	9137.	1.033	24.97	0.363</								

141.0	15030.	0.223	33.04	0.306	0.845	72.59	3.37	2.18	P	1.199	16.50	I
118.1	15030.	0.179	37.64	0.306	0.845	72.59	3.96	2.18	P	1.004	18.20	I
95.3	15030.	0.144	42.73	0.306	0.845	72.59	4.60	2.18	P	0.810	20.00	I
86.0	15030.	0.130	45.12	0.306	0.844	72.59	4.92	2.18	P	0.731	24.70	I
79.3	15030.	0.118	47.10	0.306	0.844	72.59	5.22	2.18	P	0.674	36.80	O2
74.9	15030.	0.098	49.89	0.306	0.844	72.59	5.86	2.18	P	0.636	54.00	CU
248.3	18270.	0.770	13.59	0.329	0.853	72.59	1.17	2.23	P	2.110	11.90	I
231.4	18270.	0.591	15.96	0.328	0.852	72.59	1.49	2.22	P	1.967	9.60	I
222.1	18270.	0.516	17.34	0.328	0.852	72.59	1.67	2.22	P	1.887	9.10	I
212.1	18270.	0.450	18.83	0.328	0.852	72.59	1.88	2.21	P	1.803	9.40	I
190.3	18280.	0.343	22.26	0.328	0.852	72.59	2.36	2.21	P	1.617	11.70	I
166.7	18280.	0.264	26.25	0.328	0.852	72.59	2.89	2.21	P	1.416	14.70	I
151.8	18270.	0.225	29.33	0.328	0.852	72.59	3.27	2.20	P	1.290	16.40	I
128.7	18270.	0.181	33.77	0.327	0.852	72.59	3.81	2.20	P	1.094	18.20	I
105.6	18270.	0.146	38.85	0.327	0.852	72.59	4.40	2.20	P	0.898	20.10	I
96.4	18270.	0.133	41.30	0.327	0.852	72.59	4.69	2.20	P	0.819	24.80	I
89.8	18270.	0.121	43.47	0.327	0.852	72.59	4.96	2.20	P	0.764	36.50	I
86.8	18270.	0.100	46.63	0.327	0.852	72.59	5.54	2.20	P	0.737	54.20	I

145.1	7297.	0.203	46.18	0.296	0.854	102.00	3.86	3.60	P	1.293	20.10	I	138.6	15650.	0.134	50.73	0.311	0.859	102.00	5.15	3.59	P	0.874	43.40	I
117.9	7297.	0.164	53.70	0.296	0.854	102.00	4.54	3.60	P	1.050	23.10	I	174.2	15650.	0.112	57.96	0.310	0.859	102.00	5.79	3.59	P	1.097	61.00	O2
93.6	7296.	0.134	62.30	0.296	0.854	102.00	5.26	3.60	P	0.834	26.70	I	344.5	15180.	0.779	12.25	0.283	0.849	102.00	1.20	3.60	P	2.171	11.90	HC
86.1	7296.	0.122	66.37	0.296	0.854	102.00	5.60	3.60	P	0.767	35.40	I	313.9	15170.	0.580	14.31	0.283	0.849	102.00	1.58	3.60	P	1.978	9.50	I
83.1	7296.	0.112	69.90	0.296	0.854	102.00	5.93	3.60	P	0.740	51.50	I	297.4	15160.	0.498	15.54	0.282	0.849	102.00	1.81	3.60	P	1.874	8.80	I
93.7	7295.	0.092	74.61	0.296	0.854	102.00	6.72	3.60	P	0.835	64.90	I	279.6	15150.	0.428	16.84	0.282	0.849	102.00	2.08	3.60	P	1.762	9.10	I
252.3	5393.	0.766	24.58	0.293	0.853	102.00	1.22	3.60	P	2.650	14.10	I	241.8	15140.	0.315	19.88	0.282	0.849	102.00	2.72	3.60	P	1.523	11.50	I
233.8	5392.	0.562	29.25	0.293	0.853	102.00	1.62	3.60	P	2.932	12.60	I	203.4	15130.	0.235	23.54	0.281	0.849	102.00	3.48	3.60	P	1.282	14.80	I
222.5	5392.	0.478	31.98	0.293	0.853	102.00	1.87	3.60	P	2.153	12.40	I	184.3	15100.	0.197	27.07	0.280	0.848	102.00	4.01	3.60	P	1.161	17.10	I
209.9	5392.	0.406	34.90	0.293	0.853	102.00	2.17	3.60	P	2.031	13.10	I	151.0	15100.	0.156	31.62	0.280	0.848	102.00	4.79	3.60	P	0.952	19.60	I
180.1	5391.	0.291	41.49	0.293	0.853	102.00	2.89	3.60	P	1.742	16.40	I	123.9	15090.	0.125	37.39	0.280	0.848	102.00	5.64	3.60	P	0.781	22.40	I
145.3	5391.	0.211	48.59	0.293	0.853	102.00	3.75	3.60	P	1.406	20.50	I	117.1	15090.	0.112	40.50	0.280	0.848	102.00	6.06	3.60	P	0.738	30.20	I
120.0	5392.	0.174	52.67	0.293	0.853	102.00	4.36	3.60	P	1.161	22.70	I	117.0	15090.	0.101	43.54	0.279	0.848	102.00	6.49	3.60	P	0.737	44.00	I
84.8	5392.	0.137	58.28	0.293	0.853	102.00	5.20	3.60	P	0.821	26.10	I	142.8	15080.	0.080	49.20	0.279	0.848	102.00	7.55	3.60	P	0.900	60.50	CU
51.2	5392.	0.112	62.37	0.293	0.853	102.00	5.97	3.60	P	0.495	31.30	O2	344.1	14120.	0.768	13.09	0.248	0.836	102.00	1.23	3.62	P	2.168	12.40	HC
38.6	5391.	0.104	63.19	0.293	0.853	102.00	6.27	3.60	P	0.373	59.40	O2	312.3	14100.	0.570	15.22	0.247	0.835	102.00	1.63	3.62	P	1.968	9.80	I
30.2	5391.	0.098	63.13	0.293	0.853	102.00	6.51	3.60	P	0.292	111.20	O2	295.2	14080.	0.488	16.48	0.246	0.835	102.00	1.88	3.62	P	1.860	9.10	I
26.1	5391.	0.088	60.30	0.293	0.853	102.00	6.94	3.60	P	0.253	115.90	O2	276.8	14080.	0.417	17.79	0.246	0.835	102.00	2.16	3.62	P	1.744	9.30	I
258.9	5168.	0.751	29.84	0.281	0.848	102.00	1.24	3.60	P	2.697	14.50	I	237.9	14060.	0.304	20.83	0.245	0.835	102.00	2.87	3.62	P	1.499	11.70	I
237.6	5167.	0.572	35.15	0.281	0.848	102.00	1.60	3.60	P	2.881	13.40	I	198.9	14050.	0.223	24.46	0.245	0.835	102.00	3.73	3.62	P	1.253	14.90	I
225.9	5167.	0.497	38.33	0.281	0.848	102.00	1.82	3.60	P	2.107	13.50	I	180.3	14020.	0.186	28.10	0.244	0.834	102.00	4.35	3.62	P	1.136	17.20	I
213.7	5167.	0.434	41.83	0.281	0.848	102.00	2.06	3.60	P	2.023	14.40	I	146.5	14020.	0.144	32.51	0.244	0.834	102.00	5.31	3.62	P	0.923	19.40	I
187.6	5166.	0.331	50.23	0.281	0.848	102.00	2.60	3.60	P	1.776	17.80	I	118.7	14010.	0.113	38.03	0.243	0.834	102.00	6.38	3.62	P	0.748	22.10	I
160.7	5165.	0.259	60.63	0.280	0.848	102.00	3.21	3.60	P	1.521	22.50	I	111.2	14010.	0.100	41.00	0.243	0.834	102.00	6.93	3.62	P	0.701	29.70	I
142.4	5166.	0.224	68.04	0.281	0.848	102.00	3.62	3.60	P	1.348	25.60	I	109.9	14010.	0.089	43.89	0.243	0.834	102.00	7.49	3.62	P	0.692	43.40	I
119.4	5166.	0.187	81.14	0.281	0.848	102.00	4.17	3.60	P	1.130	30.10	I	131.4	14000.	0.068	49.35	0.243	0.834	102.00	8.93	3.62	P	0.828	59.90	CU
101.6	5166.	0.158	98.35	0.281	0.848	102.00	4.74	3.60	P	0.962	36.00	I	307.0	9968.	0.769	17.18	0.255	0.839	102.00	1.23	3.62	P	2.132	12.10	I
98.5	5165.	0.147	107.90	0.281	0.848	102.00	5.01	3.60	P	0.932	44.30	I	279.5	9961.	0.578	19.89	0.254	0.838	102.00	1.60	3.62	P	1.941	10.00	I
101.2	5165.	0.137	117.70	0.280	0.848	102.00	5.28	3.60	P	0.958	58.10	I	264.7	9957.	0.498	21.48	0.254	0.838	102.00	1.84	3.62	P	1.838	9.40	I
130.2	5165.	0.116	136.60	0.280	0.848	102.00	5.92	3.60	P	1.232	76.90	O2	249.1	9955.	0.429	23.15	0.254	0.838	102.00	2.10	3.62	P	1.730	9.70	I
266.5	8193.	0.768	16.76	0.256	0.839	102.00	1.23	3.61	P	2.132	12.10	I	216.2	9950.	0.316	27.04	0.254	0.838	102.00	2.76	3.62	P	1.502	12.00	I
247.4	8189.	0.561	19.86	0.256	0.839	102.00	1.65	3.61	P	1.978	10.10	I	183.3	9945.	0.236	31.64	0.253	0.838	102.00	3.54	3.62	P	1.273	15.10	I
235.9	8186.	0.474	21.67	0.256	0.839	102.00	1.92	3.62	P	1.887	9.50	I	165.0	9937.	0.196	35.56	0.253	0.838	102.00	4.12	3.62	P	1.146	17.20	I
222.9	8185.	0.400	23.58	0.256	0.839	102.00	2.24	3.62	P	1.783	9.90	I	136.8	9935.	0.154	40.96	0.253	0.838	102.00	5.00	3.62	P	0.950	19.50	I
192.4	8183.	0.281	27.87	0.255	0.839	102.00	3.05	3.62	P	1.539	12.50	I	113.2	9933.	0.120	47.66	0.253	0.838	102.00	6.02	3.62	P	0.786	22.20	I
157.4	8181.	0.198	32.52	0.255	0.839	102.00	4.09	3.62	P	1.259	16.00	I	106.5	9932.	0.106	51.25	0.253	0.838	102.00	6.55	3.62	P	0.740	29.70	I
133.5	8179.	0.158	35.65	0.255	0.839	102.00	4.88	3.62	P	1.067	18.00	I	104.8	9932.	0.095	54.73	0.253	0.838	102.00	7.10	3.62	P	0.728	44.40	I
97.7	8178.	0.118	39.57	0.255	0.839	102.00	6.09	3.62	P	0.782	20.80	I	120.4	9930.	0.072	61.27	0.253	0.838	102.00	8.48	3.62	P	0.836	60.40	CU
62.7	8177.	0.089	42.75	0.255	0.839	102.00	7.35	3.62	P	0.502	24.90	O2	305.0	9625.	0.772	16.95	0.231	0.829	102.00	1.23	3.63	P	2.084	12.20	I
49.1	8177.	0.080	43.62	0.255	0.839	102.00	7.90	3.62	P	0.393	47.60	O2	276.7	9616.	0.573	19.58	0.230	0.829	102.00	1.63	3.63	P	1.891	9.90	I
39.5	8177.	0.073	43.84	0.255	0.839	102.00	8.38	3.62	P	0.316	94.80	O2	261.5	9611.	0.490	21.11	0.230	0.828	102.00	1.88	3.63	P	1.787	9.30	I
32.9	8176.	0.061	42.46	0.255	0.839	102.00	9.29	3.62	P	0.263	110.30	O2	245.3	9609.	0.418	22.71	0.230	0.828	102.00	2.18	3.63	P	1.676	9.50	I
278.3	7421.	0.765	22.09	0.271	0.845	102.00	1.23	3.61	P	2.327	11.90	I	211.0	9603.	0.303	26.39	0.229	0.828	102.00	2.91	3.63	P	1.442	11.80	I
255.6	7418.	0.582	25.75	0.271	0.845	102.00	1.58	3.61	P	2.137	10.50	I	176.6	9598.	0.220	30.66	0.229	0.828	102.00	3.83	3.63	P	1.207	14.90	I
243.2	7417.	0.506	27.90	0.270	0.845	102.00	1.80	3.61	P	2.034	10.20	I	157.3	9589.	0.179	34.29	0.229	0.828	102.00	4.54	3.64	P	1.075	16.90	I
230.2	7416.	0.440	30.21	0.270	0.845	102.00	2.04	3.61	P	1.925	10.70	I	127.4	9587.	0.136	39.06	0.229	0.828	102.00	5.65	3.64	P	0.870	19.00	I
202.6	7414.	0.333	35.63	0.270	0.844	102.00	2.61	3.61	P	1.694	13.20	I	101.6	9585.	0.102	44.78	0.228	0.828	102.00	6.98	3.64	P	0.695	21.50	I
174.5	7412.	0.256	42.07	0.270	0.844	102.00	3.27	3.61	P	1.459	16.50	I	93.6	9584.	0.089	47.73	0.228	0.828	102.00	7.68	3.64	P	0.640	29.80	I
157.5	7410.	0.217	47.02	0.270	0.844	102.00	3.74	3.61	P	1.317	18.70	I	90.2	9584.	0.078	50.47	0.228	0.828	102.00	8.43	3.64	P	0.616	46.10	I
133.4	7410.	0.175	54.51	0.270	0.844	102.00	4.44	3.61	P	1.115	21.40	I	100.6	9583.	0.056	55.32	0.228	0.828	102.00	10.33	3.64	P	0.688	61.30	I
113.7	7409.	0.141	63.68	0.270	0.844	102.00	5.22	3.61	P	0.951	24.40	I	297.6	10830.	0.768	17.05	0.299	0.855	102.00	1.21	3.60	P	2.100	11.40	I
108.7	7409.	0.128	68.44	0.2																					

226.8	4792.	0.486	36.88	0.230	0.828	102.00	1.90	3.63	P	2.115	13.10	I
215.2	4791.	0.415	40.21	0.230	0.828	102.00	2.19	3.63	P	2.044	13.80	I
188.6	4791.	0.300	47.88	0.230	0.828	102.00	2.93	3.63	P	1.792	17.10	I
158.6	4790.	0.219	56.62	0.229	0.828	102.00	3.85	3.63	P	1.507	21.50	I
137.0	4790.	0.179	62.19	0.230	0.828	102.00	4.55	3.63	P	1.301	23.80	I
106.5	4790.	0.138	70.51	0.230	0.828	102.00	5.60	3.63	P	1.012	27.20	I
76.9	4790.	0.107	78.55	0.230	0.828	102.00	6.75	3.63	P	0.730	30.80	I
65.6	4790.	0.096	81.58	0.230	0.828	102.00	7.29	3.63	P	0.623	43.80	O2
58.2	4790.	0.087	83.72	0.229	0.828	102.00	7.82	3.63	P	0.553	71.30	O2
56.2	4790.	0.070	84.53	0.229	0.828	102.00	8.97	3.63	P	0.533	88.10	O2
263.2	4956.	0.759	30.44	0.253	0.838	102.00	1.24	3.62	P	2.667	15.00	I
242.0	4955.	0.573	35.77	0.253	0.838	102.00	1.61	3.62	P	2.881	13.60	I
230.3	4955.	0.496	38.95	0.253	0.838	102.00	1.84	3.62	P	2.133	13.60	I
218.1	4955.	0.429	42.44	0.253	0.838	102.00	2.10	3.62	P	2.049	14.40	I
192.0	4954.	0.322	50.75	0.253	0.838	102.00	2.72	3.62	P	1.804	17.90	I
165.0	4953.	0.246	60.91	0.253	0.838	102.00	3.43	3.62	P	1.550	22.40	I
146.5	4954.	0.208	68.02	0.253	0.838	102.00	3.93	3.62	P	1.376	25.20	I
122.8	4953.	0.168	80.25	0.253	0.838	102.00	4.66	3.62	P	1.154	29.30	I
103.8	4953.	0.137	95.75	0.253	0.838	102.00	5.45	3.62	P	0.975	34.40	I
99.4	4953.	0.125	104.00	0.253	0.838	102.00	5.84	3.62	P	0.934	42.10	I
100.4	4953.	0.114	112.20	0.253	0.838	102.00	6.24	3.62	P	0.943	56.00	I
122.6	4953.	0.092	127.00	0.253	0.838	102.00	7.24	3.62	P	1.152	74.50	O2
265.6	5720.	0.792	25.95	0.325	0.864	102.00	1.17	3.59	P	2.713	14.00	I
243.4	5719.	0.600	30.50	0.325	0.864	102.00	1.51	3.59	P	2.911	12.80	I
231.1	5719.	0.520	33.18	0.325	0.864	102.00	1.71	3.59	P	2.187	12.70	I
218.2	5718.	0.452	36.13	0.325	0.864	102.00	1.94	3.59	P	2.065	13.50	I
190.2	5718.	0.342	43.07	0.325	0.864	102.00	2.46	3.59	P	1.800	16.70	I
160.9	5717.	0.265	51.36	0.325	0.864	102.00	3.04	3.59	P	1.523	20.90	I
141.0	5718.	0.227	57.10	0.325	0.864	102.00	3.44	3.59	P	1.335	23.50	I
115.1	5718.	0.187	66.58	0.325	0.864	102.00	3.98	3.59	P	1.089	27.40	I
93.3	5717.	0.157	77.86	0.325	0.864	102.00	4.52	3.59	P	0.883	31.80	I
87.5	5717.	0.145	83.46	0.325	0.864	102.00	4.78	3.59	P	0.828	40.20	I
86.7	5717.	0.135	88.63	0.325	0.864	102.00	5.03	3.59	P	0.820	54.90	I
103.4	5717.	0.114	96.64	0.325	0.864	102.00	5.63	3.59	P	0.978	69.00	I
274.6	9019.	0.782	16.47	0.304	0.857	102.00	1.19	3.59	P	2.190	11.40	I
254.3	9016.	0.584	19.67	0.304	0.856	102.00	1.56	3.59	P	2.028	9.80	I
242.9	9014.	0.502	21.61	0.303	0.856	102.00	1.78	3.59	P	1.936	9.40	I
230.4	9013.	0.432	23.73	0.303	0.856	102.00	2.04	3.59	P	1.837	9.90	I
202.8	9010.	0.321	28.84	0.303	0.856	102.00	2.63	3.59	P	1.617	12.80	I
172.7	9008.	0.244	35.08	0.303	0.856	102.00	3.31	3.59	P	1.377	16.70	I
153.3	9006.	0.207	39.93	0.303	0.856	102.00	3.77	3.59	P	1.223	19.30	I
125.2	9005.	0.168	47.36	0.303	0.856	102.00	4.42	3.59	P	0.998	22.70	I
101.4	9004.	0.139	56.09	0.303	0.856	102.00	5.07	3.59	P	0.809	26.60	I
95.4	9003.	0.128	60.24	0.303	0.856	102.00	5.38	3.59	P	0.761	35.80	I
95.2	9003.	0.118	63.74	0.303	0.856	102.00	5.69	3.59	P	0.759	49.90	I
115.8	9003.	0.097	67.95	0.303	0.856	102.00	6.45	3.59	P	0.924	62.00	I
274.7	9009.	0.781	16.46	0.303	0.856	102.00	1.19	3.59	P	2.190	11.30	I
254.2	9005.	0.583	19.66	0.303	0.856	102.00	1.56	3.59	P	2.027	9.70	I
242.7	9004.	0.502	21.58	0.303	0.856	102.00	1.79	3.59	P	1.935	9.40	I
230.2	9002.	0.432	23.70	0.303	0.856	102.00	2.04	3.59	P	1.835	9.80	I
202.4	9000.	0.320	28.78	0.303	0.856	102.00	2.64	3.59	P	1.614	12.70	I
172.3	8998.	0.243	34.99	0.303	0.856	102.00	3.32	3.59	P	1.374	16.60	I
153.1	8995.	0.206	39.86	0.302	0.856	102.00	3.79	3.60	P	1.221	19.10	I
125.0	8994.	0.167	47.30	0.302	0.856	102.00	4.44	3.60	P	0.997	22.60	I
101.4	8993.	0.138	56.09	0.302	0.856	102.00	5.10	3.60	P	0.809	26.50	I
95.5	8993.	0.127	60.31	0.302	0.856	102.00	5.41	3.60	P	0.762	35.50	I
95.5	8993.	0.116	63.94	0.302	0.856	102.00	5.73	3.60	P	0.761	49.50	I
116.8	8992.	0.096	68.50	0.302	0.856	102.00	6.50	3.60	P	0.931	61.80	I

APPENDIX C
CONVECTIVE CONDENSATION RAW HEAT TRANSFER
AND PRESSURE DROP DATA WITHIN A MICRO-FIN TUBE

APPENDIX C1

Convective condensation of R32 within a micro-fin tube

(file: taraw.tbl)

q'' (W/m ²)	ΔT_s (K)	x_c	\dot{m}_f (kg/s)	P_f (Pa)	T_f (°C)	z_f (m)	T_i (°C)	z_w (m)	T_w (°C)	M flow (g/mole)													
21946.	4.072	0.747	0.01033	1610640.	23.186	0.125	9.186	0.712	19.364	52.02	P	3626.	2.393	0.098	0.01867	2281270.	36.582	5.938	32.846	5.301	34.210	52.02	P
3391.	2.206	0.078	0.01867	2281175.	36.580	6.532	33.202	5.913	34.272	52.02	P	3391.	2.206	0.078	0.01867	2281175.	36.580	6.532	33.202	5.913	34.272	52.02	P
30885.	5.631	0.762	0.01414	1836843.	28.109	0.125	10.043	0.712	22.689	52.02	P	30885.	5.631	0.762	0.01414	1836843.	28.109	0.125	10.043	0.712	22.689	52.02	P
24339.	4.899	0.568	0.01414	1835993.	28.091	0.738	14.336	1.325	22.845	52.02	P	24339.	4.899	0.568	0.01414	1835993.	28.091	0.738	14.336	1.325	22.845	52.02	P
21374.	4.554	0.487	0.01414	1835565.	28.083	1.352	17.354	1.634	23.222	52.02	P	21374.	4.554	0.487	0.01414	1835565.	28.083	1.352	17.354	1.634	23.222	52.02	P
18670.	4.232	0.417	0.01414	1835242.	28.076	1.964	19.766	1.939	24.690	52.02	P	18670.	4.232	0.417	0.01414	1835242.	28.076	1.964	19.766	1.939	24.690	52.02	P
13894.	3.634	0.304	0.01414	1834611.	28.063	2.577	21.637	2.550	23.803	52.02	P	13894.	3.634	0.304	0.01414	1834611.	28.063	2.577	21.637	2.550	23.803	52.02	P
10069.	3.112	0.222	0.01414	1833994.	28.050	3.174	22.761	3.148	24.982	52.02	P	10069.	3.112	0.222	0.01414	1833994.	28.050	3.174	22.761	3.148	24.982	52.02	P
8069.	2.803	0.182	0.01414	1833230.	28.034	3.504	23.482	3.530	25.131	52.02	P	8069.	2.803	0.182	0.01414	1833230.	28.034	3.504	23.482	3.530	25.131	52.02	P
4097.	1.675	0.164	0.01033	1608724.	23.142	4.103	20.235	4.078	21.869	52.02	P	4097.	1.675	0.164	0.01033	1608724.	23.142	4.103	20.235	4.078	21.869	52.02	P
2897.	1.384	0.133	0.01033	1608272.	23.132	4.714	20.739	4.688	21.789	52.02	P	2897.	1.384	0.133	0.01033	1608272.	23.132	4.714	20.739	4.688	21.789	52.02	P
2527.	1.253	0.120	0.01033	1608042.	23.127	5.325	21.118	4.997	21.920	52.02	P	2527.	1.253	0.120	0.01033	1608042.	23.127	5.325	21.118	4.997	21.920	52.02	P
2319.	1.143	0.109	0.01033	1608116.	23.128	5.938	21.389	5.301	21.968	52.02	P	2319.	1.143	0.109	0.01033	1608116.	23.128	5.938	21.389	5.301	21.968	52.02	P
2370.	0.955	0.088	0.01033	1608312.	23.133	6.532	21.552	5.913	22.043	52.02	P	2370.	0.955	0.088	0.01033	1608312.	23.133	6.532	21.552	5.913	22.043	52.02	P
25608.	4.852	0.763	0.01164	1729295.	25.829	0.125	9.537	0.712	21.192	52.02	P	25608.	4.852	0.763	0.01164	1729295.	25.829	0.125	9.537	0.712	21.192	52.02	P
20116.	4.194	0.572	0.01164	1729511.	25.834	0.738	13.459	1.325	21.331	52.02	P	20116.	4.194	0.572	0.01164	1729511.	25.834	0.738	13.459	1.325	21.331	52.02	P
17630.	3.888	0.492	0.01164	1729620.	25.836	1.352	16.225	1.634	21.700	52.02	P	17630.	3.888	0.492	0.01164	1729620.	25.836	1.352	16.225	1.634	21.700	52.02	P
15365.	3.595	0.423	0.01164	1729419.	25.832	1.964	18.384	1.939	22.934	52.02	P	15365.	3.595	0.423	0.01164	1729419.	25.832	1.964	18.384	1.939	22.934	52.02	P
11370.	3.056	0.312	0.01164	1728963.	25.822	2.577	20.070	2.550	22.204	52.02	P	11370.	3.056	0.312	0.01164	1728963.	25.822	2.577	20.070	2.550	22.204	52.02	P
8179.	2.592	0.233	0.01164	1728517.	25.812	3.174	21.058	3.148	23.225	52.02	P	8179.	2.592	0.233	0.01164	1728517.	25.812	3.174	21.058	3.148	23.225	52.02	P
6514.	2.327	0.193	0.01164	1728172.	25.805	3.504	21.720	3.530	23.316	52.02	P	6514.	2.327	0.193	0.01164	1728172.	25.805	3.504	21.720	3.530	23.316	52.02	P
4619.	1.998	0.152	0.01164	1728015.	25.801	4.103	22.389	4.078	24.203	52.02	P	4619.	1.998	0.152	0.01164	1728015.	25.801	4.103	22.389	4.078	24.203	52.02	P
3210.	1.695	0.120	0.01164	1727841.	25.798	4.714	22.967	4.688	24.108	52.02	P	3210.	1.695	0.120	0.01164	1727841.	25.798	4.714	22.967	4.688	24.108	52.02	P
2775.	1.566	0.107	0.01164	1727753.	25.796	5.325	23.372	4.997	24.320	52.02	P	2775.	1.566	0.107	0.01164	1727753.	25.796	5.325	23.372	4.997	24.320	52.02	P
2531.	1.456	0.096	0.01164	1727670.	25.794	5.938	23.667	5.301	24.381	52.02	P	2531.	1.456	0.096	0.01164	1727670.	25.794	5.938	23.667	5.301	24.381	52.02	P
2593.	1.283	0.075	0.01164	1727505.	25.790	6.532	23.852	5.913	24.331	52.02	P	2593.	1.283	0.075	0.01164	1727505.	25.790	6.532	23.852	5.913	24.331	52.02	P
16787.	3.252	0.762	0.00836	2041944.	32.192	0.125	20.962	0.712	29.239	52.02	P	16787.	3.252	0.762	0.00836	2041944.	32.192	0.125	20.962	0.712	29.239	52.02	P
13299.	2.837	0.577	0.00836	2042132.	32.195	0.738	23.494	1.325	29.023	52.02	P	13299.	2.837	0.577	0.00836	2042132.	32.195	0.738	23.494	1.325	29.023	52.02	P
11715.	2.641	0.499	0.00836	2042227.	32.197	1.352	25.419	1.634	29.319	52.02	P	11715.	2.641	0.499	0.00836	2042227.	32.197	1.352	25.419	1.634	29.319	52.02	P
10268.	2.453	0.432	0.00836	2042120.	32.195	1.964	26.739	1.939	30.142	52.02	P	10268.	2.453	0.432	0.00836	2042120.	32.195	1.964	26.739	1.939	30.142	52.02	P
7702.	2.103	0.322	0.00836	2041869.	32.190	2.577	27.850	2.550	29.703	52.02	P	7702.	2.103	0.322	0.00836	2041869.	32.190	2.577	27.850	2.550	29.703	52.02	P
5636.	1.795	0.243	0.00836	2041625.	32.186	3.174	28.551	3.148	30.455	52.02	P	5636.	1.795	0.243	0.00836	2041625.	32.186	3.174	28.551	3.148	30.455	52.02	P
4549.	1.622	0.202	0.00836	2041791.	32.189	3.504	29.162	3.530	30.506	52.02	P	4549.	1.622	0.202	0.00836	2041791.	32.189	3.504	29.162	3.530	30.506	52.02	P
3291.	1.394	0.160	0.00836	2041761.	32.188	4.103	29.514	4.078	31.136	52.02	P	3291.	1.394	0.160	0.00836	2041761.	32.188	4.103	29.514	4.078	31.136	52.02	P
2322.	1.174	0.126	0.00836	2041728.	32.188	4.714	30.014	4.688	31.045	52.02	P	2322.	1.174	0.126	0.00836	2041728.	32.188	4.714	30.014	4.688	31.045	52.02	P
2004.	1.076	0.112	0.00836	2041711.	32.187	5.325	30.139	4.997	31.129	52.02	P	2004.	1.076	0.112	0.00836	2041711.	32.187	5.325	30.139	4.997	31.129	52.02	P
1805.	0.989	0.101	0.00836	2041666.	32.187	5.938	30.386	5.301	31.181	52.02	P	1805.	0.989	0.101	0.00836	2041666.	32.187	5.938	30.386	5.301	31.181	52.02	P
1745.	0.839	0.079	0.00836	2041569.	32.185	6.532	30.587	5.913	31.227	52.02	P	1745.	0.839	0.079	0.00836	2041569.	32.185	6.532	30.587	5.913	31.227	52.02	P
19375.	3.826	0.781	0.00957	2217378.	35.445	0.125	22.801	0.712	31.946	52.02	P	19375.	3.826	0.781	0.00957	2217378.	35.445	0.125	22.801	0.712	31.946	52.02	P
15169.	3.322	0.590	0.00957	2217148.	35.441	0.738	25.793	1.325	31.738	52.02	P	15169.	3.322	0.590	0.00957	2217148.	35.441	0.738	25.793	1.325	31.738	52.02	P
13267.	3.085	0.511	0.00957	2217032.	35.439	1.352	27.957	1.634	32.064	52.02	P	13267.	3.085	0.511	0.00957	2217032.	35.439	1.352	27.957	1.634	32.064	52.02	P
11537.	2.862	0.442	0.00957	2216890.	35.436	1.964	29.525	1.939	33.074	52.02	P	11537.	2.862	0.442	0.00957	2216890.	35.436	1.964	29.525	1.939	33.074	52.02	P
8493.	2.446	0.332	0.00957	2216600.	35.431	2.577	30.763	2.550	32.580	52.02	P	8493.	2.446	0.332	0.00957	2216600.	35.431	2.577	30.763	2.550	32.580	52.02	P
6074.	2.083	0.254	0.00957	2216317.	35.426	3.174	31.519	3.148	33.373	52.02	P	6074.	2.083	0.254	0.00957	2216317.	35.426	3.174	31.519	3.148	33.373	52.02	P
4820.	1.876	0.215	0.00957	2216330.	35.426	3.504	32.124	3.530	33.498	52.02	P	4820.	1.876	0.215	0.00957	2216330.	35.426	3.504	32.124	3.530	33.498	52.02	P
3404.	1.608	0.175	0.00957	2216281.	35.425	4.103	32.545	4.078	34.166	52.02	P	3404.	1.608	0.175	0.00957	2216281.	35.425	4.103	32.545	4.078	34.166	52.02	P
2374.	1.352	0.144	0.00957	2216226.	35.424	4.714	33.050	4.688	34.096	52.02	P	2374.	1.352	0.144	0.00957	2216226.	35.424	4.714	33.050	4.688	34.096	52.02	P
2069.	1.239	0.131	0.00957	2216198.	35.424	5.325	33.235	4.997	34.214	52.02	P	2069.	1.239	0.131	0.00957	2216198.	35.424	5.325	33.235	4.997	34.214	52.02	P
1912.	1.139	0.121	0.00957	2216162.	35.423	5.938	33.486	5.301	34														

14684.	4.482	0.442	0.01005	1947085.	30.344	5.938	19.624	5.301	25.917	52.02	C
16938.	5.677	0.283	0.01005	1946926.	30.341	6.532	17.589	5.913	24.089	52.02	C
815.	0.593	1.004	0.00538	2016100.	32.361	0.125	31.317	0.712	31.645	52.02	C
1575.	0.046	0.981	0.00538	2015991.	31.693	0.738	31.080	1.325	31.510	52.02	C
1976.	0.136	0.964	0.00538	2015936.	31.692	1.352	30.886	1.634	31.395	52.02	C
2383.	0.240	0.944	0.00538	2015827.	31.690	1.964	30.633	1.939	31.453	52.02	C
3235.	0.505	0.890	0.00538	2015598.	31.685	2.577	30.265	2.550	30.917	52.02	C
4113.	0.834	0.822	0.00538	2015374.	31.681	3.174	29.869	3.148	31.218	52.02	C
4699.	1.083	0.769	0.00538	2015337.	31.680	3.504	29.514	3.530	30.816	52.02	C
5571.	1.491	0.681	0.00538	2015254.	31.679	4.103	28.833	4.078	30.606	52.02	C
6585.	2.012	0.566	0.00538	2015162.	31.677	4.714	27.991	4.688	29.817	52.02	C
7116.	2.304	0.500	0.00538	2015116.	31.676	5.325	26.900	4.997	29.121	52.02	C
7651.	2.610	0.430	0.00538	2015077.	31.675	5.938	25.742	5.301	29.061	52.02	C
8763.	3.281	0.274	0.00538	2015000.	31.674	6.532	24.674	5.913	28.166	52.02	C
853.	-0.095	0.999	0.00489	2218042.	35.457	0.125	35.034	0.712	35.547	52.02	C
1590.	0.011	0.973	0.00489	2217956.	35.456	0.738	34.741	1.325	35.313	52.02	C
1961.	0.088	0.953	0.00489	2217912.	35.455	1.352	34.546	1.634	35.200	52.02	C
2325.	0.180	0.930	0.00489	2217823.	35.453	1.964	34.283	1.939	35.248	52.02	C
3054.	0.412	0.872	0.00489	2217635.	35.450	2.577	33.900	2.550	34.790	52.02	C
3763.	0.700	0.800	0.00489	2217451.	35.447	3.174	33.534	3.148	35.059	52.02	C
4215.	0.921	0.745	0.00489	2217599.	35.449	3.504	33.349	3.530	34.686	52.02	C
4861.	1.278	0.657	0.00489	2217558.	35.448	4.103	32.657	4.078	34.505	52.02	C
5576.	1.735	0.545	0.00489	2217511.	35.448	4.714	31.983	4.688	33.861	52.02	C
5937.	1.991	0.482	0.00489	2217488.	35.447	5.325	30.933	4.997	33.261	52.02	C
6291.	2.259	0.416	0.00489	2217455.	35.447	5.938	30.021	5.301	33.229	52.02	C
7002.	2.845	0.272	0.00489	2217387.	35.445	6.532	29.258	5.913	32.377	52.02	C
808.	0.466	1.004	0.00555	2176792.	35.304	0.125	34.394	0.712	34.779	52.02	C
1565.	-0.002	0.981	0.00555	2176679.	34.708	0.738	34.144	1.325	34.555	52.02	C
1965.	0.090	0.965	0.00555	2176622.	34.707	1.352	33.953	1.634	34.427	52.02	C
2373.	0.199	0.944	0.00555	2176516.	34.705	1.964	33.703	1.939	34.487	52.02	C
3228.	0.476	0.891	0.00555	2176294.	34.701	2.577	33.340	2.550	33.954	52.02	C
4113.	0.819	0.823	0.00555	2176077.	34.697	3.174	32.942	3.148	34.252	52.02	C
4704.	1.080	0.770	0.00555	2176038.	34.697	3.504	32.578	3.530	33.825	52.02	C
5586.	1.505	0.683	0.00555	2175965.	34.695	4.103	31.891	4.078	33.622	52.02	C
6613.	2.049	0.568	0.00555	2175883.	34.694	4.714	31.031	4.688	32.814	52.02	C
7153.	2.354	0.502	0.00555	2175842.	34.693	5.325	29.956	4.997	32.088	52.02	C
7697.	2.673	0.432	0.00555	2175794.	34.692	5.938	28.768	5.301	32.017	52.02	C
8829.	3.372	0.276	0.00555	2175697.	34.690	6.532	27.684	5.913	31.082	52.02	C
843.	0.463	1.004	0.00560	2304611.	37.558	0.125	36.487	0.712	37.055	52.02	C
1609.	0.019	0.980	0.00560	2304507.	36.989	0.738	36.169	1.325	36.816	52.02	C
2007.	0.109	0.963	0.00560	2304455.	36.988	1.352	35.970	1.634	36.695	52.02	C
2406.	0.216	0.942	0.00560	2304353.	36.986	1.964	35.695	1.939	36.745	52.02	C
3229.	0.485	0.888	0.00560	2304139.	36.983	2.577	35.305	2.550	36.222	52.02	C
4063.	0.821	0.819	0.00560	2303930.	36.979	3.174	34.922	3.148	36.520	52.02	C
4611.	1.076	0.766	0.00560	2303958.	36.980	3.504	34.691	3.530	36.107	52.02	C
5418.	1.490	0.680	0.00560	2303889.	36.978	4.103	33.953	4.078	35.905	52.02	C
6342.	2.021	0.568	0.00560	2303813.	36.977	4.714	33.169	4.688	35.117	52.02	C
6822.	2.319	0.504	0.00560	2303774.	36.976	5.325	32.005	4.997	34.406	52.02	C
7302.	2.630	0.437	0.00560	2303720.	36.975	5.938	30.895	5.301	34.375	52.02	C
8290.	3.311	0.287	0.00560	2303608.	36.973	6.532	29.976	5.913	33.419	52.02	C
1290.	1.140	1.007	0.00761	1566603.	23.508	0.125	21.824	0.712	22.110	52.02	C
2486.	-0.035	0.983	0.00761	1566004.	22.154	0.738	21.636	1.325	21.929	52.02	C
3117.	0.090	0.965	0.00761	1565703.	22.147	1.352	21.350	1.634	21.810	52.02	C
3756.	0.247	0.944	0.00761	1565730.	22.148	1.964	21.016	1.939	21.902	52.02	C
5092.	0.644	0.889	0.00761	1565842.	22.150	2.577	20.491	2.550	21.161	52.02	C
6467.	1.137	0.819	0.00761	1565951.	22.153	3.174	19.826	3.148	21.574	52.02	C
7384.	1.471	0.764	0.00761	1564516.	22.119	3.504	19.049	3.530	21.066	52.02	C
8746.	2.062	0.674	0.00761	1564108.	22.110	4.103	18.067	4.078	20.627	52.02	C
10328.	2.820	0.556	0.00761	1563654.	22.099	4.714	16.696	4.688	19.610	52.02	C
11157.	3.245	0.488	0.00761	1563424.	22.094	5.325	15.088	4.997	18.534	52.02	C
11991.	3.696	0.417	0.00761	1563437.	22.094	5.938	13.343	5.301	18.415	52.02	C
13724.	4.685	0.256	0.00761	1563502.	22.095	6.532	11.625	5.913	16.929	52.02	C
1052.	0.937	1.005	0.00604	1599801.	23.983	0.125	22.554	0.712	22.882	52.02	C
2019.	0.022	0.981	0.00604	1599366.	22.927	0.738	22.361	1.325	22.740	52.02	C
2524.	0.120	0.963	0.00604	1599146.	22.922	1.352	22.120	1.634	22.604	52.02	C
3034.	0.246	0.941	0.00604	1599280.	22.926	1.964	21.828	1.939	22.701	52.02	C
4094.	0.562	0.885	0.00604	1599611.	22.933	2.577	21.379	2.550	22.073	52.02	C
5177.	0.953	0.813	0.00604	1599934.	22.941	3.174	20.855	3.148	22.410	52.02	C
5893.	1.231	0.758	0.00604	1599505.	22.931	3.504	20.314	3.530	21.994	52.02	C
6954.	1.691	0.667	0.00604	1599049.	22.920	4.103	19.505	4.078	21.721	52.02	C
8178.	2.282	0.548	0.00604	1598543.	22.909	4.714	18.459	4.688	20.852	52.02	C
8817.	2.613	0.481	0.00604	1598286.	22.903	5.325	17.134	4.997	19.949	52.02	C
9457.	2.967	0.409	0.00604	1598359.	22.904	5.938	15.751	5.301	19.881	52.02	C
10783.	3.745	0.249	0.00604	1598559.	22.909	6.532	14.425	5.913	18.931	52.02	C
3617.	8.560	1.052	0.02038	2138438.	42.634	0.125	33.039	0.712	33.890	52.02	C
6792.	4.370	1.026	0.02038	2136986.	38.074	0.738	32.336	1.325	33.354	52.02	C
8410.	1.448	1.006	0.02038	2136255.	34.881	1.352	31.664	1.634	33.000	52.02	C
10015.	0.837	0.982	0.02038	2135278.	33.948	1.964	30.852	1.939	33.145	52.02	C
13271.	1.613	0.923	0.02038	2133272.	33.911	2.577	29.673	2.550	31.382	52.02	C
16495.	2.586	0.848	0.02038	2131311.	33.874	3.174	28.265	3.148	32.311	52.02	C
18581.	3.191	0.792	0.02038	2123135.	33.723	3.504	26.904	3.530	31.210	52.02	C
21603.	4.399	0.700	0.02038	2121625.	33.695	4.103	24.827	4.078	30.122	52.02	C
25003.	5.951	0.581	0.02038	2119946.	33.663	4.714	22.172	4.688	28.302	52.02	C
26743.	6.822	0.515	0.02038	2119096.	33.648	5.325	18.975	4.997	26.085	52.02	C
28467.	7.742	0.445	0.02038	2118675.	33.640	5.938	15.478	5.301	25.998	52.02	C
31972.	9.761	0.290	0.02038	2117894.	33.625	6.532	12.257	5.913	23.236	52.02	C
3225.	7.008	1.044	0.01532	2182092.	41.926	0.125	33.925	0.712	34.746	52.02	C
5969.	2.161	1.013	0.01532	2181269.	36.754	0.738	33.326	1.325	34.292	52.02	C
7336.	0.430	0.990	0.01532	2180854.	34.784	1.352	32.750	1.634	33.983	52.02	C
8672.	0.702	0.962	0.01532	2180260.	34.774	1.964	32.044	1.939	34.113	52.02	C
11324.	1.395	0.894	0.01532	2179035.	34.751	2.577	31.012	2.550	32.658	52.02	C
13872.	2.259	0.809	0.01532	2177837.	34.729	3.174	29.819	3.148	33.387	52.02	C
15483.	2.841	0.746	0.01532	2173255.	34.646	3.504	28.762	3.530	32.355	52.02	C
17762.	3.911	0.643	0.01532	2172384.	34.630	4.103	26.998	4.078	31.285	52.02	C
20255.	5.885	0.514	0.01532	2171416.	34.612	4.714	24.845	4.688	29.797	52.02	C
21502.	6.055	0.441	0.01532	2170926.	34.603	5.325	22.149	4.997	27.934	52.02	C
22719.	6.866	0.366	0.01532	2170692.	34.599	5.938	19.381	5.301	27.840	52.02	C
25136.	8.645	0.202	0.01532	2170259.	34.591	6.532	17.056	5.913	25.450	52.0	

9344.	1.905	0.702	0.00842	1779653.	26.910	3.504	23.169	3.530	25.303	52.02	C	1315.	0.939	0.079	0.00667	1732103.	25.890	5.938	24.616	5.301	24.850	52.02	P
10517.	2.583	0.598	0.00842	1779351.	26.903	4.103	22.135	4.078	24.843	52.02	C	1321.	0.848	0.060	0.00667	1732000.	25.888	6.532	24.729	5.913	24.947	52.02	P
11732.	3.453	0.469	0.00842	1779017.	26.896	4.714	20.809	4.688	23.724	52.02	C	16606.	3.399	0.758	0.00745	1832874.	28.027	0.125	15.564	0.712	24.993	52.02	P
12312.	3.940	0.398	0.00842	1778847.	26.892	5.325	19.323	4.997	22.523	52.02	C	12916.	2.893	0.561	0.00745	1832750.	28.024	0.738	18.732	1.325	24.759	52.02	P
12860.	4.451	0.325	0.00842	1778759.	26.891	5.938	17.789	5.301	22.402	52.02	C	11249.	2.659	0.480	0.00745	1832688.	28.023	1.352	20.967	1.634	25.109	52.02	P
13892.	5.574	0.169	0.00842	1778594.	26.887	6.532	16.543	5.913	21.067	52.02	C	9733.	2.441	0.411	0.00745	1832588.	28.021	1.964	22.635	1.939	25.904	52.02	P
1237.	2.370	0.103	0.00668	1805227.	29.876	0.125	26.894	0.712	27.355	52.02	C	7066.	2.044	0.299	0.00745	1832381.	28.017	2.577	23.913	2.550	25.544	52.02	P
2328.	0.093	0.987	0.00668	1805186.	27.449	0.738	26.615	1.325	27.188	52.02	C	4948.	1.709	0.222	0.00745	1832179.	28.012	3.174	24.659	3.148	26.492	52.02	P
2884.	0.202	0.967	0.00668	1805166.	27.448	1.352	26.354	1.634	27.043	52.02	C	3849.	1.530	0.185	0.00745	1832420.	28.017	3.504	25.221	3.530	26.415	52.02	P
3436.	0.329	0.944	0.00668	1805012.	27.445	1.964	26.024	1.939	27.146	52.02	C	2612.	1.303	0.146	0.00745	1832399.	28.017	4.103	25.675	4.078	27.096	52.02	P
4555.	0.651	0.885	0.00668	1804679.	27.438	2.577	25.518	2.550	26.469	52.02	C	1715.	1.102	0.118	0.00745	1832376.	28.016	4.714	26.095	4.688	26.979	52.02	P
5663.	1.051	0.812	0.00668	1804354.	27.431	3.174	24.975	3.148	26.801	52.02	C	1451.	1.021	0.108	0.00745	1832364.	28.016	5.325	26.325	4.997	26.934	52.02	P
6381.	1.344	0.755	0.00668	1803703.	27.418	3.504	24.535	3.530	26.351	52.02	C	1318.	0.954	0.099	0.00745	1832316.	28.015	5.938	26.516	5.301	27.023	52.02	P
7419.	1.840	0.664	0.00668	1803516.	27.414	4.103	23.662	4.078	26.064	52.02	C	1428.	0.860	0.081	0.00745	1832212.	28.013	6.532	26.659	5.913	27.055	52.02	P
8588.	2.475	0.546	0.00668	1803308.	27.409	4.714	22.631	4.688	25.162	52.02	C	14453.	3.020	0.748	0.00671	2006084.	31.501	0.125	20.715	0.712	28.886	52.02	P
9187.	2.831	0.480	0.00668	1803202.	27.407	5.325	21.250	4.997	24.265	52.02	C	11240.	2.583	0.553	0.00671	2006020.	31.500	0.738	23.458	1.325	28.531	52.02	P
9779.	3.205	0.410	0.00668	1803133.	27.405	5.938	19.925	5.301	24.183	52.02	C	9788.	2.380	0.472	0.00671	2005988.	31.499	1.352	25.401	1.634	28.780	52.02	P
10984.	4.024	0.257	0.00668	1802999.	27.403	6.532	18.695	5.913	23.102	52.02	C	8468.	2.189	0.403	0.00671	2005903.	31.498	1.964	26.851	1.939	29.597	52.02	P
28299.	5.093	0.772	0.01255	1769243.	26.688	0.125	10.081	0.712	21.836	52.02	P	6148.	1.839	0.293	0.00671	2005724.	31.494	2.577	27.970	2.550	29.318	52.02	P
22265.	4.432	0.575	0.01255	1768557.	26.674	0.738	14.056	1.325	21.927	52.02	P	4307.	1.539	0.216	0.00671	2005549.	31.491	3.174	28.630	3.148	30.177	52.02	P
19534.	4.121	0.492	0.01255	1768211.	26.666	1.352	16.822	1.634	22.229	52.02	P	3353.	1.377	0.178	0.00671	2005868.	31.497	3.504	29.114	3.530	30.091	52.02	P
17046.	3.830	0.421	0.01255	1767942.	26.660	1.964	19.050	1.939	23.582	52.02	P	2281.	1.166	0.140	0.00671	2005844.	31.496	4.103	29.506	4.078	30.657	52.02	P
12656.	3.292	0.306	0.01255	1767413.	26.649	2.577	20.755	2.550	22.745	52.02	P	1506.	0.973	0.112	0.00671	2005817.	31.496	4.714	29.861	4.688	30.525	52.02	P
9151.	2.822	0.223	0.01255	1766897.	26.638	3.174	21.783	3.148	23.872	52.02	P	1280.	0.891	0.102	0.00671	2005804.	31.496	5.325	30.065	4.997	30.589	52.02	P
7325.	2.544	0.182	0.01255	1766244.	26.624	3.504	22.416	3.530	23.920	52.02	P	1168.	0.821	0.092	0.00671	2005763.	31.495	5.938	30.240	5.301	30.604	52.02	P
5243.	2.201	0.138	0.01255	1766092.	26.621	4.103	23.138	4.078	24.806	52.02	P	1273.	0.713	0.074	0.00671	2005676.	31.493	6.532	30.379	5.913	30.707	52.02	P
3695.	1.876	0.104	0.01255	1765923.	26.617	4.714	23.699	4.688	24.789	52.02	P	13801.	2.898	0.757	0.00670	2218118.	35.458	0.125	25.016	0.712	32.981	52.02	P
3218.	1.734	0.090	0.01255	1765837.	26.615	5.325	24.184	4.997	24.968	52.02	P	10728.	2.479	0.563	0.00670	2218019.	35.457	0.738	27.627	1.325	32.568	52.02	P
2950.	1.608	0.078	0.01255	1765754.	26.614	5.938	24.485	5.301	25.002	52.02	P	9341.	2.283	0.483	0.00670	2217969.	35.456	1.352	29.516	1.634	32.837	52.02	P
3019.	1.399	0.056	0.01255	1765587.	26.610	6.532	24.672	5.913	25.050	52.02	P	8079.	2.100	0.415	0.00670	2217884.	35.454	1.964	30.886	1.939	33.630	52.02	P
24134.	4.685	0.773	0.01192	2069719.	32.721	0.125	17.775	0.712	28.262	52.02	P	5863.	1.762	0.305	0.00670	2217708.	35.451	2.577	31.955	2.550	33.387	52.02	P
19116.	4.056	0.586	0.01192	2069239.	32.712	0.738	21.105	1.325	28.333	52.02	P	4107.	1.471	0.229	0.00670	2217536.	35.448	3.174	32.592	3.148	34.184	52.02	P
16837.	3.762	0.507	0.01192	2068997.	32.707	1.352	23.578	1.634	28.659	52.02	P	3199.	1.313	0.192	0.00670	2217857.	35.454	3.504	33.092	3.530	34.113	52.02	P
14757.	3.488	0.439	0.01192	2068776.	32.703	1.964	25.380	1.939	29.869	52.02	P	2181.	1.106	0.154	0.00670	2217835.	35.453	4.103	33.428	4.078	34.671	52.02	P
11072.	2.980	0.328	0.01192	2068334.	32.694	2.577	26.838	2.550	29.234	52.02	P	1449.	0.914	0.126	0.00670	2217810.	35.453	4.714	33.802	4.688	34.522	52.02	P
8109.	2.542	0.248	0.01192	2067903.	32.686	3.174	27.771	3.148	30.220	52.02	P	1239.	0.832	0.116	0.00670	2217797.	35.453	5.325	33.956	4.997	34.644	52.02	P
6552.	2.289	0.207	0.01192	2067547.	32.679	3.504	28.540	3.530	30.262	52.02	P	1138.	0.761	0.107	0.00670	2217761.	35.452	5.938	34.138	5.301	34.617	52.02	P
4755.	1.975	0.163	0.01192	2067413.	32.677	4.103	29.004	4.078	31.049	52.02	P	1251.	0.649	0.088	0.00670	2217684.	35.451	6.532	34.303	5.913	34.719	52.02	P
3380.	1.681	0.129	0.01192	2067265.	32.674	4.714	29.641	4.688	30.990	52.02	P	14319.	3.022	0.749	0.00658	2073059.	32.784	0.125	22.253	0.712	30.154	52.02	P
2933.	1.554	0.115	0.01192	2067190.	32.673	5.325	29.862	4.997	31.123	52.02	P	11103.	2.580	0.549	0.00658	2072982.	32.782	0.738	24.990	1.325	29.817	52.02	P
2657.	1.445	0.103	0.01192	2067129.	32.672	5.938	30.183	5.301	31.237	52.02	P	9652.	2.374	0.467	0.00658	2072943.	32.782	1.352	26.892	1.634	30.066	52.02	P
2596.	1.269	0.081	0.01192	2067010.	32.669	6.532	30.450	5.913	31.304	52.02	P	8334.	2.182	0.397	0.00658	2072858.	32.780	1.964	28.354	1.939	30.904	52.02	P
28506.	5.247	0.772	0.01290	1832715.	28.023	0.125	11.228	0.712	22.998	52.02	P	6022.	1.829	0.285	0.00658	2072680.	32.777	2.577	29.459	2.550	30.631	52.02	P
22432.	4.551	0.577	0.01290	1832014.	28.009	0.738	15.223	1.325	23.150	52.02	P	4194.	1.528	0.207	0.00658	2072506.	32.773	3.174	30.097	3.148	31.448	52.02	P
19683.	4.225	0.495	0.01290	1831661.	28.002	1.352	18.019	1.634	23.450	52.02	P	3252.	1.366	0.170	0.00658	2072833.	32.780	3.504	30.552	3.530	31.405	52.02	P
17178.	3.921	0.425	0.01290	1831388.	27.996	1.964	20.247	1.939	24.853	52.02	P	2200.	1.155	0.132	0.00658	2072817.	32.779	4.103	30.955	4.078	31.937	52.02	P
12758.	3.359	0.310	0.01290	1830851.	27.985	2.577	21.960	2.550	24.032	52.02	P	1453.	0.963	0.104	0.00658	2072800.	32.779	4.714	31.275	4.688	31.786	52.02	P
9228.	2.871	0.228	0.01290	1830327.	27.974	3.174	22.999	3.148	25.156	52.02	P	1244.	0.882	0.094	0.00658	2072792.	32.779	5.325	31.506	4.997	31.912	52.02	P
7388.	2.586	0.187	0.01290	1829760.	27.962	3.504	23.670	3.530	25.222	52.02	P	1150.	0.814	0.084	0.00658	2072749.	32.778	5.938	31.668	5.301	31.876	52.02	P
5291.	2.235	0.144	0.01290	1829592.	27.959	4.103	24.370	4.078	26.099	52.02	P	1294.	0.710	0.066	0.00658	2072658.	32.776	6.532	31.812	5.913	32.		

APPENDIX C2

Convective condensation of R125 within a micro-fin tube

(file: taraw.tbl)

q'' (W/m ²)	ΔT_s (K)	x_g	m_g (kg/s)	P_i (Pa)	T_i (°C)	z_i (m)	T_f (°C)	z_w (m)	T_w (°C)	M flow (g/mole)
858.	6.763	1.073	0.01379	1553765.	36.522	0.125	29.346	0.712	29.555	120.02 C
1665.	4.788	1.050	0.01379	1553473.	34.316	0.738	28.882	1.325	29.328	120.02 C
2096.	3.320	1.033	0.01379	1553326.	32.679	1.352	28.553	1.634	29.120	120.02 C
2536.	1.564	1.012	0.01379	1553025.	30.722	1.964	28.142	1.939	29.132	120.02 C
3466.	0.988	0.957	0.01379	1552393.	29.638	2.577	27.556	2.550	28.358	120.02 C
4433.	1.602	0.887	0.01379	1551776.	29.623	3.174	26.759	3.148	28.486	120.02 C
5085.	2.022	0.833	0.01379	1549710.	29.571	3.504	26.016	3.530	27.925	120.02 C
6059.	2.783	0.743	0.01379	1549262.	29.559	4.103	24.875	4.078	27.256	120.02 C
7201.	3.758	0.623	0.01379	1548765.	29.547	4.714	23.310	4.688	26.147	120.02 C
7803.	4.305	0.554	0.01379	1548513.	29.540	5.325	21.321	4.997	24.939	120.02 C
8411.	4.880	0.481	0.01379	1548344.	29.536	5.938	19.144	5.301	24.650	120.02 C
9681.	6.141	0.317	0.01379	1548018.	29.528	6.532	17.176	5.913	22.972	120.02 C
724.	6.471	1.080	0.01379	1798569.	42.071	0.125	35.248	0.712	35.442	120.02 C
1426.	4.917	1.059	0.01379	1798280.	40.306	0.738	34.730	1.325	35.209	120.02 C
1807.	3.751	1.043	0.01379	1798134.	38.985	1.352	34.430	1.634	35.008	120.02 C
2199.	2.350	1.024	0.01379	1797870.	37.400	1.964	34.058	1.939	35.011	120.02 C
3039.	0.901	0.973	0.01379	1797319.	35.486	2.577	33.523	2.550	34.319	120.02 C
3927.	1.464	0.907	0.01379	1796781.	35.474	3.174	32.826	3.148	34.396	120.02 C
4532.	1.861	0.855	0.01379	1795221.	35.439	3.504	32.255	3.530	33.916	120.02 C
5445.	2.559	0.768	0.01379	1794868.	35.431	4.103	31.199	4.078	33.334	120.02 C
6526.	3.454	0.653	0.01379	1794476.	35.422	4.714	29.809	4.688	32.290	120.02 C
7100.	3.955	0.586	0.01379	1794277.	35.417	5.325	27.978	4.997	31.227	120.02 C
7683.	4.481	0.514	0.01379	1794125.	35.414	5.938	25.980	5.301	30.924	120.02 C
8908.	5.635	0.353	0.01379	1793826.	35.407	6.532	24.070	5.913	29.378	120.02 C
1810.	1.447	1.007	0.01818	1729308.	34.517	0.125	32.588	0.712	33.124	120.02 C
3215.	1.043	0.971	0.01818	1728603.	33.910	0.738	32.079	1.325	32.821	120.02 C
3866.	1.183	0.945	0.01818	1728247.	33.901	1.352	31.641	1.634	32.496	120.02 C
4469.	1.349	0.915	0.01818	1727786.	33.891	1.964	31.124	1.939	32.653	120.02 C
5566.	1.773	0.842	0.01818	1726841.	33.869	2.577	30.456	2.550	31.636	120.02 C
6492.	2.304	0.757	0.01818	1725917.	33.847	3.174	29.736	3.148	31.893	120.02 C
7013.	2.652	0.695	0.01818	1723023.	33.780	3.504	29.309	3.530	31.300	120.02 C
7650.	3.317	0.600	0.01818	1722484.	33.767	4.103	28.330	4.078	30.731	120.02 C
8214.	4.171	0.486	0.01818	1721884.	33.753	4.714	27.294	4.688	29.742	120.02 C
8442.	4.650	0.425	0.01818	1721580.	33.746	5.325	25.952	4.997	28.705	120.02 C
8629.	5.154	0.364	0.01818	1721380.	33.741	5.938	24.708	5.301	28.647	120.02 C
8891.	6.260	0.237	0.01818	1720994.	33.732	6.532	23.659	5.913	27.399	120.02 C
2541.	2.966	1.026	0.02847	1981893.	41.303	0.125	37.712	0.712	38.323	120.02 C
4582.	1.450	0.990	0.02847	1980581.	39.478	0.738	37.038	1.325	37.880	120.02 C
5556.	1.662	0.964	0.02847	1979919.	39.464	1.352	36.448	1.634	37.438	120.02 C
6481.	1.915	0.935	0.02847	1979148.	39.448	1.964	35.743	1.939	37.673	120.02 C
8230.	2.561	0.861	0.02847	1977578.	39.415	2.577	34.809	2.550	36.172	120.02 C
9802.	3.371	0.774	0.02847	1976044.	39.382	3.174	33.816	3.148	36.558	120.02 C
10736.	3.881	0.710	0.02847	1970214.	39.260	3.504	33.020	3.530	35.744	120.02 C
11979.	4.893	0.609	0.02847	1969244.	39.239	4.103	31.550	4.078	34.804	120.02 C
13225.	6.192	0.485	0.02847	1968165.	39.216	4.714	29.823	4.688	33.363	120.02 C
13803.	6.921	0.417	0.02847	1967618.	39.205	5.325	27.803	4.997	31.721	120.02 C
14336.	7.688	0.348	0.02847	1967271.	39.197	5.938	25.722	5.301	31.580	120.02 C
15301.	9.372	0.201	0.02847	1966604.	39.183	6.532	23.925	5.913	29.560	120.02 C
2266.	2.235	1.020	0.02787	2193984.	44.949	0.125	42.112	0.712	42.776	120.02 C
4088.	1.328	0.985	0.02787	2192884.	43.762	0.738	41.462	1.325	42.282	120.02 C
4960.	1.523	0.960	0.02787	2192329.	43.751	1.352	40.933	1.634	41.874	120.02 C
5787.	1.755	0.931	0.02787	2191684.	43.739	1.964	40.284	1.939	42.072	120.02 C
7356.	2.346	0.859	0.02787	2190370.	43.713	2.577	39.434	2.550	40.755	120.02 C
8768.	3.087	0.773	0.02787	2189086.	43.688	3.174	38.552	3.148	41.189	120.02 C
9609.	3.568	0.711	0.02787	2184337.	43.596	3.504	37.890	3.530	40.385	120.02 C
10731.	4.491	0.612	0.02787	2183552.	43.584	4.103	36.517	4.078	39.478	120.02 C
11859.	5.675	0.489	0.02787	2182680.	43.564	4.714	34.987	4.688	38.172	120.02 C
12384.	6.340	0.423	0.02787	2182238.	43.555	5.325	33.111	4.997	36.715	120.02 C
12870.	7.037	0.355	0.02787	2181918.	43.549	5.938	31.227	5.301	36.576	120.02 C
13753.	8.568	0.210	0.02787	2181291.	43.537	6.532	29.621	5.913	34.755	120.02 C
3242.	2.806	1.016	0.02649	1442728.	28.353	0.125	25.006	0.712	25.531	120.02 C
5760.	1.550	0.974	0.02649	1440944.	26.745	0.738	24.400	1.325	25.043	120.02 C
6931.	1.785	0.945	0.02649	1440045.	26.720	1.352	23.663	1.634	24.539	120.02 C
8019.	2.064	0.911	0.02649	1438986.	26.692	1.964	22.857	1.939	24.857	120.02 C
10011.	2.782	0.828	0.02649	1436828.	26.635	2.577	21.778	2.550	22.985	120.02 C
11707.	3.688	0.731	0.02649	1434720.	26.578	3.174	20.548	3.148	22.655	120.02 C
12662.	4.194	0.662	0.02649	1426665.	26.362	3.504	19.309	3.530	22.539	120.02 C
13856.	5.340	0.554	0.02649	1425401.	26.328	4.103	17.734	4.078	21.521	120.02 C
14937.	6.812	0.422	0.02649	1423997.	26.290	4.714	15.699	4.688	19.870	120.02 C
15387.	7.639	0.353	0.02649	1423285.	26.271	5.325	13.534	4.997	17.948	120.02 C
15766.	8.516	0.282	0.02649	1422959.	26.262	5.938	11.287	5.301	17.806	120.02 C
16335.	10.440	0.135	0.02649	1422364.	26.246	6.532	9.460	5.913	15.572	120.02 C
2858.	3.418	1.025	0.02702	1643882.	34.104	0.125	29.920	0.712	30.704	120.02 C
5109.	1.497	0.987	0.02702	1642290.	31.861	0.738	29.230	1.325	30.226	120.02 C
6167.	1.713	0.960	0.02702	1641488.	31.841	1.352	28.572	1.634	29.765	120.02 C
7160.	1.972	0.929	0.02702	1640563.	31.819	1.964	27.799	1.939	30.037	120.02 C
9004.	2.634	0.852	0.02702	1638683.	31.773	2.577	26.771	2.550	28.367	120.02 C
10612.	3.467	0.761	0.02702	1636846.	31.729	3.174	25.694	3.148	28.931	120.02 C
11541.	3.954	0.696	0.02702	1629794.	31.557	3.504	24.815	3.530	27.942	120.02 C
12736.	5.003	0.593	0.02702	1628670.	31.530	4.103	23.273	4.078	27.001	120.02 C
13876.	6.350	0.467	0.02702	1627420.	31.500	4.714	21.471	4.688	25.481	120.02 C
14377.	7.106	0.400	0.02702	1626786.	31.484	5.325	19.314	4.997	23.765	120.02 C
14821.	7.905	0.331	0.02702	1626444.	31.476	5.938	17.205	5.301	23.643	120.02 C
15564.	9.659	0.187	0.02702	1625799.	31.460	6.532	15.458	5.913	21.595	120.02 C
2525.	3.028	1.024	0.02726	1769504.	36.770	0.125	33.087	0.712	33.752	120.02 C
4547.	1.374	0.989	0.02726	1768033.	34.820	0.738	32.446	1.325	33.319	120.02 C
5511.	1.574	0.964	0.02726	1767292.	34.803	1.352	31.855	1.634	32.895	120.02 C
6424.	1.812	0.935	0.02726	1766438.	34.784	1.964	31.156	1.939	33.132	120.02 C
8148.	2.423	0.864	0.02726	1764702.	34.744	2.577	30.222	2.550	31.633	120.02 C
9691.	3.191	0.779	0.02726	1763005.	34.705	3.174	29.237	3.148	32.137	120.02 C
10604.	3.648	0.718	0.02726	1756545.	34.556	3.504	28.444	3.530	31.208	120.02 C
11815.	4.612	0.620	0.02726	1755478.	34.532	4.103	27.017	4.078	30.361	120.02 C
13022.	5.851	0.500	0.02726	1754292.	34.505	4.714	25.336	4.688	28.956	120.02 C
13578.	6.547	0.435	0.02726	1753691.	34.491	5.325	23.335	4.997	27.379	120.02 C
14089.	7.280	0.368	0.02726	1753316.	34.482	5.938	21.322	5.301	27.269	120.02 C
15007.	8.890	0.226	0.02726	1752595.	34.465	6.532	19.530	5.913	25.384	120.02 C
1031.	1.599	1.016	0.01180	1909153.	39.122	0.125	37.090	0.712	37.483	120.02 C
1859.	0.957	0.982	0.01180	1908909.	37.952	0.73				

9427.	5.717	0.398	0.01360	1387402.	25.294	5.938	12.574	5.301	19.590	120.02	C	11879.	4.705	0.521	0.02035	1549401.	29.563	1.352	19.986	1.634	24.832	120.02	P
10924.	7.195	0.219	0.01360	1387115.	25.286	6.532	10.219	5.913	17.445	120.02	C	10499.	4.312	0.452	0.02035	1549042.	29.554	1.964	21.974	1.939	25.989	120.02	P
1479.	4.159	1.040	0.02132	1459475.	31.127	0.125	26.304	0.712	26.816	120.02	C	8034.	3.607	0.339	0.02035	1548336.	29.536	2.577	23.554	2.550	25.539	120.02	P
2821.	2.019	1.015	0.02132	1458480.	28.679	0.738	25.812	1.325	26.415	120.02	C	6022.	3.025	0.255	0.02035	1547646.	29.518	3.174	24.511	3.148	26.477	120.02	P
3521.	0.763	0.997	0.02132	1457978.	27.197	1.352	25.282	1.634	26.070	120.02	C	4942.	2.691	0.213	0.02035	1546513.	29.490	3.504	25.181	3.530	26.579	120.02	P
4227.	1.011	0.975	0.02132	1457255.	27.178	1.964	24.650	1.939	26.198	120.02	C	3669.	2.322	0.166	0.02035	1546237.	29.483	4.103	25.830	4.078	27.444	120.02	P
5689.	1.648	0.918	0.02132	1455764.	27.139	2.577	23.753	2.550	24.937	120.02	C	2641.	2.018	0.128	0.02035	1545931.	29.475	4.714	26.396	4.688	27.367	120.02	P
7177.	2.448	0.846	0.02132	1454306.	27.100	3.174	22.717	3.148	25.384	120.02	C	2276.	1.906	0.112	0.02035	1545776.	29.471	5.325	26.805	4.997	27.507	120.02	P
8161.	2.925	0.792	0.02132	1448540.	26.947	3.504	21.593	3.530	24.560	120.02	C	2018.	1.824	0.099	0.02035	1545637.	29.467	5.938	27.105	5.301	27.637	120.02	P
9614.	3.923	0.701	0.02132	1447406.	26.917	4.103	20.029	4.078	23.484	120.02	C	1806.	1.743	0.076	0.02035	1545360.	29.460	6.532	27.343	5.913	27.774	120.02	P
11286.	5.206	0.583	0.02132	1446145.	26.883	4.714	17.898	4.688	22.098	120.02	C	18462.	6.486	0.791	0.02110	1410543.	25.926	0.125	9.019	0.712	19.369	120.02	P
12158.	5.926	0.515	0.02132	1445506.	26.866	5.325	15.265	4.997	20.455	120.02	C	14826.	5.505	0.601	0.02110	1409530.	25.899	0.738	12.588	1.325	20.146	120.02	P
13031.	6.688	0.444	0.02132	1445153.	26.857	5.938	12.408	5.301	20.154	120.02	C	13164.	5.056	0.520	0.02110	1409019.	25.885	1.352	15.289	1.634	20.821	120.02	P
14837.	8.362	0.285	0.02132	1444486.	26.839	6.532	9.689	5.913	18.081	120.02	C	11638.	4.645	0.450	0.02110	1408623.	25.874	1.964	17.534	1.939	22.058	120.02	P
1773.	4.667	1.047	0.02178	1591035.	34.940	0.125	29.489	0.712	30.112	120.02	C	8907.	3.910	0.333	0.02110	1407848.	25.853	2.577	19.289	2.550	21.476	120.02	P
3322.	2.275	1.018	0.02178	1590072.	32.192	0.738	28.880	1.325	29.630	120.02	C	6668.	3.305	0.247	0.02110	1407091.	25.832	3.174	20.342	3.148	22.529	120.02	P
4110.	0.912	0.906	0.02178	1589587.	30.569	1.352	28.275	1.634	29.224	120.02	C	5462.	2.954	0.203	0.02110	1405757.	25.796	3.504	21.051	3.530	22.585	120.02	P
4891.	1.205	0.970	0.02178	1588897.	30.552	1.964	27.560	1.939	29.397	120.02	C	4030.	2.576	0.155	0.02110	1405470.	25.788	4.103	21.802	4.078	23.540	120.02	P
6473.	1.952	0.904	0.02178	1587472.	30.517	2.577	26.535	2.550	27.943	120.02	C	2858.	2.267	0.116	0.02110	1405150.	25.780	4.714	22.397	4.688	23.416	120.02	P
8038.	2.887	0.822	0.02178	1586081.	30.482	3.174	25.372	3.148	28.369	120.02	C	2433.	2.155	0.101	0.02110	1404988.	25.775	5.325	22.865	4.997	23.563	120.02	P
9048.	3.486	0.761	0.02178	1580881.	30.353	3.504	24.205	3.530	27.449	120.02	C	2126.	2.074	0.088	0.02110	1404845.	25.771	5.938	23.169	5.301	23.682	120.02	P
10511.	4.652	0.659	0.02178	1579937.	30.329	4.103	22.437	4.078	26.302	120.02	C	1840.	2.001	0.066	0.02110	1404559.	25.763	6.532	23.390	5.913	23.824	120.02	P
12153.	6.149	0.528	0.02178	1578887.	30.303	4.714	20.097	4.688	24.657	120.02	C	14810.	5.629	0.785	0.02076	1822186.	36.046	0.125	22.157	0.712	30.393	120.02	P
12993.	6.988	0.455	0.02178	1578355.	30.290	5.325	17.233	4.997	22.782	120.02	C	11917.	4.775	0.611	0.02076	1821414.	36.028	0.738	24.991	1.325	31.045	120.02	P
13824.	7.874	0.378	0.02178	1578076.	30.283	5.938	14.221	5.301	22.410	120.02	C	10595.	4.382	0.537	0.02076	1821025.	36.020	1.352	27.226	1.634	31.554	120.02	P
15513.	9.816	0.208	0.02178	1577551.	30.270	6.532	11.597	5.913	19.944	120.02	C	9383.	4.020	0.473	0.02076	1820698.	36.012	1.964	28.930	1.939	32.659	120.02	P
925.	0.312	1.000	0.01803	1867675.	37.054	0.125	36.192	0.712	36.601	120.02	C	7216.	3.367	0.365	0.02076	1820049.	35.998	2.577	30.337	2.550	32.331	120.02	P
1793.	0.519	0.979	0.01803	1867062.	37.040	0.738	35.778	1.325	36.344	120.02	C	5446.	2.822	0.285	0.02076	1819416.	35.984	3.174	31.222	3.148	33.127	120.02	P
2255.	0.673	0.963	0.01803	1866752.	37.033	1.352	35.434	1.634	36.106	120.02	C	4496.	2.507	0.245	0.02076	1818324.	35.959	3.504	31.886	3.530	33.276	120.02	P
2726.	0.856	0.945	0.01803	1866325.	37.024	1.964	35.001	1.939	36.212	120.02	C	3374.	2.152	0.199	0.02076	1818068.	35.953	4.103	32.415	4.078	34.044	120.02	P
3720.	1.321	0.896	0.01803	1865446.	37.005	2.577	34.371	2.550	35.337	120.02	C	2466.	1.849	0.162	0.02076	1817783.	35.947	4.714	32.991	4.688	34.026	120.02	P
4752.	1.902	0.833	0.01803	1864587.	36.986	3.174	33.681	3.148	35.510	120.02	C	2142.	1.732	0.147	0.02076	1817639.	35.944	5.325	33.289	4.997	34.165	120.02	P
5445.	2.294	0.785	0.01803	1861922.	36.927	3.504	33.112	3.530	34.986	120.02	C	1913.	1.641	0.134	0.02076	1817482.	35.940	5.938	33.607	5.301	34.287	120.02	P
6483.	3.018	0.704	0.01803	1861369.	36.915	4.103	31.992	4.078	34.332	120.02	C	1720.	1.532	0.110	0.02076	1817164.	35.933	6.532	33.865	5.913	34.448	120.02	P
7696.	3.947	0.597	0.01803	1860755.	36.902	4.714	30.580	4.688	33.259	120.02	C	19624.	6.569	0.788	0.02773	1820884.	36.016	0.125	20.351	0.712	29.267	120.02	P
8335.	4.468	0.536	0.01803	1860443.	36.895	5.325	28.736	4.997	32.115	120.02	C	15803.	5.604	0.615	0.02773	1819567.	35.987	0.738	23.534	1.325	30.289	120.02	P
8980.	5.015	0.470	0.01803	1860227.	36.890	5.938	26.743	5.301	31.892	120.02	C	14060.	5.157	0.542	0.02773	1818903.	35.972	1.352	25.977	1.634	30.755	120.02	P
10326.	6.216	0.324	0.01803	1859807.	36.881	6.532	24.806	5.913	30.320	120.02	C	12464.	4.747	0.478	0.02773	1818384.	35.960	1.964	27.974	1.939	32.112	120.02	P
1401.	4.737	1.064	0.02019	2048019.	45.288	0.125	39.963	0.712	40.477	120.02	C	9618.	4.003	0.371	0.02773	1817367.	35.938	2.577	29.529	2.550	31.526	120.02	P
2633.	2.988	1.035	0.02019	2047430.	43.234	0.738	39.323	1.325	40.010	120.02	C	7303.	3.378	0.291	0.02773	1816373.	35.915	3.174	30.522	3.148	32.383	120.02	P
3262.	1.747	1.014	0.02019	2047132.	41.769	1.352	38.819	1.634	39.643	120.02	C	6068.	2.989	0.250	0.02773	1813899.	35.860	3.504	31.205	3.530	32.676	120.02	P
3887.	1.092	0.988	0.02019	2046696.	40.848	1.964	38.233	1.939	39.764	120.02	C	4619.	2.573	0.204	0.02773	1813395.	35.848	4.103	31.883	4.078	33.520	120.02	P
5157.	1.744	0.923	0.02019	2045794.	40.830	2.577	37.396	2.550	38.594	120.02	C	3463.	2.209	0.166	0.02773	1812835.	35.836	4.714	32.504	4.688	33.556	120.02	P
6419.	2.557	0.842	0.02019	2044913.	40.812	3.174	36.467	3.148	38.817	120.02	C	3059.	2.065	0.150	0.02773	1812552.	35.830	5.325	32.945	4.997	33.720	120.02	P
7238.	3.120	0.781	0.02019	2041956.	40.751	3.504	35.672	3.530	38.098	120.02	C	2783.	1.951	0.136	0.02773	1812299.	35.824	5.938	33.310	5.301	33.874	120.02	P
8425.	4.129	0.681	0.02019	2041441.	40.741	4.103	34.186	4.078	37.184	120.02	C	2587.	1.799	0.110	0.02773	1811793.	35.813	6.532	33.620	5.913	34.077	120.02	P
9765.	5.422	0.551	0.02019	2040868.	40.729	4.714	32.341	4.688	35.706	120.02	C	22505.	6.866	0.785	0.02789	1454394.	27.102	0.125	9.202	0.712	20.117	120.02	P
10452.	6.147	0.478	0.02019	2040578.	40.723	5.325	30.012	4.997	34.166	120.02	C	18173.	5.932	0.608	0.02789	1452699.	27.058	0.738	12.830	1.325	20.939	120.02	P
11134.	6.908	0.402	0.02019	2040380.	40.719	5.938	27.557	5.301	33.840	120.02	C	16195.	5.496	0.532	0.02789	1451845.	27.035	1.352	15.588	1.634	21.495	120.02	P
12521.	8.576	0.232	0.02019	2039994.	40.711	6.532	25.375	5.913	31.687	120.02	C	143											

2633.	1.844	0.200	0.01328	1900960.	37.780	3.504	34.749	3.530	35.768	120.02	P
1851.	1.571	0.159	0.01328	1900713.	37.774	4.103	35.161	4.078	36.402	120.02	P
1268.	1.350	0.127	0.01328	1900439.	37.768	4.714	35.588	4.688	36.362	120.02	P
1088.	1.272	0.115	0.01328	1900300.	37.765	5.325	35.805	4.997	36.414	120.02	P
987.	1.217	0.104	0.01328	1900177.	37.763	5.938	36.025	5.301	36.526	120.02	P
1011.	1.172	0.084	0.01328	1899932.	37.757	6.532	36.230	5.913	36.643	120.02	P
6031.	2.696	0.782	0.01042	2256177.	44.977	0.125	37.498	0.712	42.412	120.02	P
4761.	2.278	0.621	0.01042	2256055.	44.975	0.738	39.072	1.325	42.453	120.02	P
4187.	2.085	0.554	0.01042	2255994.	44.973	1.352	40.388	1.634	42.786	120.02	P
3664.	1.905	0.496	0.01042	2255884.	44.971	1.964	41.275	1.939	43.317	120.02	P
2743.	1.577	0.401	0.01042	2255655.	44.967	2.577	42.025	2.550	43.312	120.02	P
2008.	1.300	0.332	0.01042	2255431.	44.963	3.174	42.483	3.148	43.742	120.02	P
1625.	1.151	0.298	0.01042	2255569.	44.965	3.504	42.885	3.530	43.705	120.02	P
1192.	0.960	0.261	0.01042	2255398.	44.962	4.103	43.079	4.078	44.143	120.02	P
873.	0.791	0.230	0.01042	2255207.	44.958	4.714	43.431	4.688	44.148	120.02	P
776.	0.723	0.218	0.01042	2255111.	44.957	5.325	43.508	4.997	44.191	120.02	P
724.	0.666	0.207	0.01042	2255003.	44.955	5.938	43.693	5.301	44.270	120.02	P
748.	0.586	0.186	0.01042	2254783.	44.950	6.532	43.905	5.913	44.378	120.02	P
18113.	7.062	0.800	0.02401	2138906.	42.704	0.125	24.651	0.712	35.569	120.02	P
14253.	5.883	0.599	0.02401	2138146.	42.689	0.738	28.836	1.325	36.535	120.02	P
12504.	5.344	0.515	0.02401	2137763.	42.682	1.352	31.984	1.634	37.279	120.02	P
10909.	4.851	0.443	0.02401	2137477.	42.676	1.964	34.440	1.939	38.659	120.02	P
8093.	3.971	0.326	0.02401	2136920.	42.665	2.577	36.310	2.550	38.433	120.02	P
5839.	3.252	0.242	0.02401	2136375.	42.654	3.174	37.409	3.148	39.261	120.02	P
4657.	2.852	0.201	0.02401	2135379.	42.634	3.504	38.174	3.530	39.605	120.02	P
3312.	2.399	0.158	0.02401	2135019.	42.627	4.103	38.913	4.078	40.475	120.02	P
2303.	2.033	0.123	0.02401	2134620.	42.619	4.714	39.518	4.688	40.497	120.02	P
1988.	1.903	0.110	0.02401	2134417.	42.615	5.325	39.965	4.997	40.618	120.02	P
1806.	1.814	0.099	0.02401	2134294.	42.613	5.938	40.276	5.301	40.788	120.02	P
1826.	1.742	0.077	0.02401	2134059.	42.608	6.532	40.566	5.913	40.963	120.02	P
18333.	6.720	0.820	0.02573	2177632.	43.465	0.125	27.629	0.712	36.643	120.02	P
14741.	5.715	0.626	0.02573	2176777.	43.448	0.738	30.820	1.325	37.556	120.02	P
13102.	5.253	0.544	0.02573	2176345.	43.440	1.352	33.367	1.634	38.094	120.02	P
11599.	4.830	0.472	0.02573	2175993.	43.433	1.964	35.303	1.939	39.428	120.02	P
8916.	4.067	0.352	0.02573	2175298.	43.420	2.577	36.863	2.550	39.064	120.02	P
6728.	3.436	0.263	0.02573	2174619.	43.406	3.174	37.862	3.148	39.809	120.02	P
5556.	3.068	0.218	0.02573	2173025.	43.375	3.504	38.604	3.530	40.133	120.02	P
4176.	2.657	0.167	0.02573	2172575.	43.366	4.103	39.232	4.078	40.951	120.02	P
3066.	2.313	0.125	0.02573	2172075.	43.357	4.714	39.871	4.688	40.970	120.02	P
2674.	2.183	0.108	0.02573	2171821.	43.352	5.325	40.224	4.997	41.106	120.02	P
2399.	2.087	0.094	0.02573	2171706.	43.349	5.938	40.564	5.301	41.264	120.02	P
2184.	1.983	0.067	0.02573	2171494.	43.345	6.532	40.882	5.913	41.428	120.02	P

2460.	9.619	1.064	0.01607	1670956.	34.849	0.125	24.629	0.712	25.123	72.59	C
4528.	5.085	1.032	0.01607	1670168.	30.021	0.738	24.112	1.325	24.748	72.59	C
5548.	1.910	1.009	0.01607	1669771.	26.630	1.352	23.579	1.634	24.441	72.59	C
6538.	0.788	0.983	0.01607	1669164.	25.253	1.964	22.981	1.939	24.530	72.59	C
8483.	1.394	0.917	0.01607	1667907.	25.214	2.577	22.101	2.550	23.202	72.59	C
10327.	2.154	0.837	0.01607	1666680.	25.173	3.174	20.940	3.148	23.731	72.59	C
11483.	2.636	0.777	0.01607	1661847.	25.054	3.503	19.851	3.530	22.863	72.59	C
13094.	3.581	0.682	0.01607	1660864.	25.017	4.104	18.411	4.078	21.893	72.59	C
14828.	4.795	0.563	0.01607	1659771.	24.974	4.714	16.508	4.688	20.507	72.59	C
15686.	5.476	0.497	0.01607	1659217.	24.952	5.325	14.311	4.997	18.863	72.59	C
16515.	6.201	0.429	0.01607	1659135.	24.940	5.938	11.915	5.301	18.750	72.59	C
18143.	7.792	0.283	0.01607	1659042.	24.917	6.532	9.713	5.913	16.910	72.59	C
1830.	0.518	1.003	0.01648	2079270.	34.117	0.125	32.949	0.712	33.481	72.59	C
3425.	0.397	0.978	0.01648	2078545.	33.758	0.738	32.502	1.325	33.194	72.59	C
4231.	0.562	0.961	0.01648	2078180.	33.748	1.352	32.095	1.634	32.946	72.59	C
5028.	0.757	0.939	0.01648	2077663.	33.734	1.964	31.590	1.939	33.086	72.59	C
6634.	1.252	0.886	0.01648	2076598.	33.705	2.577	30.863	2.550	32.018	72.59	C
8210.	1.872	0.819	0.01648	2075557.	33.674	3.174	29.968	3.148	32.331	72.59	C
9226.	2.281	0.769	0.01648	2071817.	33.594	3.504	29.287	3.530	31.600	72.59	C
10683.	3.051	0.688	0.01648	2071073.	33.567	4.103	28.059	4.078	30.917	72.59	C
12308.	4.041	0.584	0.01648	2070245.	33.534	4.714	26.553	4.688	29.769	72.59	C
13135.	4.596	0.527	0.01648	2069826.	33.517	5.325	24.645	4.997	28.461	72.59	C
13951.	5.180	0.466	0.01648	2069559.	33.503	5.938	22.618	5.301	28.369	72.59	C
15597.	6.463	0.334	0.01648	2069047.	33.473	6.532	20.719	5.913	26.784	72.59	C
2831.	1.307	1.006	0.02640	1853786.	30.101	0.125	28.146	0.712	28.695	72.59	C
5309.	0.724	0.984	0.02640	1851543.	29.216	0.738	27.623	1.325	28.300	72.59	C
6566.	0.919	0.967	0.02640	1850412.	29.190	1.352	27.033	1.634	27.944	72.59	C
7811.	1.151	0.947	0.02640	1849044.	29.158	1.964	26.360	1.939	28.167	72.59	C
10326.	1.748	0.897	0.02640	1846252.	29.091	2.577	25.394	2.550	26.630	72.59	C
12806.	2.505	0.836	0.02640	1843524.	29.024	3.174	24.111	3.148	27.284	72.59	C
14409.	2.874	0.789	0.02640	1832030.	28.775	3.504	22.938	3.530	26.302	72.59	C
16716.	3.827	0.713	0.02640	1829891.	28.717	4.103	21.308	4.078	25.415	72.59	C
19301.	5.055	0.617	0.02640	1827515.	28.652	4.714	19.175	4.688	23.882	72.59	C
20620.	5.746	0.563	0.02640	1826311.	28.618	5.325	16.613	4.997	22.245	72.59	C
21923.	6.480	0.506	0.02640	1825583.	28.595	5.938	13.720	5.301	22.169	72.59	C
24566.	8.093	0.382	0.02640	1824191.	28.547	6.532	10.902	5.913	20.222	72.59	C
3501.	14.431	1.099	0.02052	1823306.	42.767	0.125	27.826	0.712	28.416	72.59	C
6351.	9.442	1.063	0.02052	1822109.	37.429	0.738	27.011	1.325	27.793	72.59	C
7724.	5.961	1.037	0.02052	1821506.	33.721	1.352	26.295	1.634	27.360	72.59	C
9035.	2.097	1.007	0.02052	1820644.	29.522	1.964	25.531	1.939	27.513	72.59	C
11544.	1.865	0.934	0.02052	1818865.	28.520	2.577	24.478	2.550	25.822	72.59	C
13835.	2.768	0.847	0.02052	1817126.	28.469	3.174	23.094	3.148	26.497	72.59	C
15223.	3.324	0.783	0.02052	1810066.	28.309	3.504	21.859	3.530	25.419	72.59	C
17092.	4.449	0.682	0.02052	1808742.	28.265	4.103	20.166	4.078	24.286	72.59	C
19012.	5.897	0.585	0.02052	1807271.	28.214	4.714	17.979	4.688	22.698	72.59	C
19923.	6.710	0.490	0.02052	1806525.	28.188	5.325	15.475	4.997	20.766	72.59	C
20778.	7.569	0.421	0.02052	1806152.	28.170	5.938	12.804	5.301	20.664	72.59	C
22376.	9.457	0.275	0.02052	1805459.	28.134	6.532	10.363	5.913	18.474	72.59	C
2957.	5.125	1.038	0.02781	2035292.	37.651	0.125	31.768	0.712	32.520	72.59	C
5552.	2.413	1.014	0.02781	2033324.	34.621	0.738	31.110	1.325	32.001	72.59	C
6872.	0.892	0.997	0.02781	2032332.	32.868	1.352	30.479	1.634	31.613	72.59	C
8181.	1.141	0.976	0.02781	2031030.	32.839	1.964	29.749	1.939	31.805	72.59	C
10831.	1.779	0.925	0.02781	2028356.	32.778	2.577	28.724	2.550	30.254	72.59	C
13451.	2.585	0.861	0.02781	2025744.	32.716	3.174	27.410	3.148	30.920	72.59	C
15148.	3.006	0.813	0.02781	2014419.	32.487	3.504	26.310	3.530	29.887	72.59	C
17596.	4.017	0.734	0.02781	2012357.	32.433	4.103	24.547	4.078	28.957	72.59	C
20345.	5.317	0.634	0.02781	2010066.	32.372	4.714	22.350	4.688	27.362	72.59	C
21750.	6.048	0.578	0.02781	2008904.	32.341	5.325	19.535	4.997	25.603	72.59	C
23141.	6.823	0.519	0.02781	2008193.	32.318	5.938	16.486	5.301	25.602	72.59	C
25965.	8.525	0.391	0.02781	2006828.	32.271	6.532	13.588	5.913	23.500	72.59	C
3651.	9.102	1.073	0.02847	2196802.	44.706	0.125	34.808	0.712	35.763	72.59	C
6766.	5.857	1.044	0.02847	2194949.	41.074	0.738	33.900	1.325	34.940	72.59	C
8322.	3.591	1.023	0.02847	2194015.	38.525	1.352	33.133	1.634	34.459	72.59	C
9845.	1.310	0.997	0.02847	2192796.	35.908	1.964	32.268	1.939	34.661	72.59	C
12874.	2.103	0.935	0.02847	2190294.	35.851	2.577	31.067	2.550	32.840	72.59	C
15795.	3.099	0.859	0.02847	2187850.	35.793	3.174	29.541	3.148	33.594	72.59	C
17650.	3.687	0.802	0.02847	2177428.	35.591	3.504	28.268	3.530	32.332	72.59	C
20276.	4.931	0.711	0.02847	2175644.	35.543	4.103	26.225	4.078	31.181	72.59	C
23156.	6.529	0.595	0.02847	2173662.	35.488	4.714	23.670	4.688	29.486	72.59	C
24602.	7.427	0.531	0.02847	2172656.	35.460	5.325	20.451	4.997	27.308	72.59	C
26014.	8.375	0.465	0.02847	2172101.	35.439	5.938	17.049	5.301	27.174	72.59	C
28829.	10.458	0.320	0.02847	2171050.	35.398	6.532	13.942	5.913	24.570	72.59	C
2696.	2.048	1.012	0.02289	1741411.	28.519	0.125	25.784	0.712	26.384	72.59	C
5018.	0.633	0.987	0.02289	1739618.	26.821	0.738	25.286	1.325	26.005	72.59	C
6182.	0.819	0.970	0.02289	1738714.	26.799	1.352	24.724	1.634	25.672	72.59	C
7327.	1.037	0.949	0.02289	1737576.	26.770	1.964	24.090	1.939	25.869	72.59	C
9614.	1.601	0.896	0.02289	1735246.	26.710	2.577	23.186	2.550	24.433	72.59	C
11834.	2.314	0.831	0.02289	1732971.	26.650	3.174	21.999	3.148	25.054	72.59	C
13254.	2.679	0.783	0.02289	1723514.	26.434	3.504	20.944	3.530	24.148	72.59	C
15273.	3.575	0.704	0.02289	1721714.	26.382	4.103	19.440	4.078	23.304	72.59	C
17503.	4.730	0.605	0.02289	1719714.	26.322	4.714	17.512	4.688	21.930	72.59	C
18628.	5.379	0.549	0.02289	1718700.	26.292	5.325	15.166	4.997	20.269	72.59	C
19732.	6.069	0.492	0.02289	1718093.	26.270	5.938	12.611	5.301	20.226	72.59	C
21945.	7.584	0.366	0.02289	1716935.	26.226	6.532	10.104	5.913	18.434	72.59	C
1304.	7.601	1.056	0.01002	1817819.	36.380	0.125	28.248	0.712	28.493	72.59	C
2470.	3.860	1.028	0.01002	1817611.	32.391	0.738	27.846	1.325	28.271	72.59	C
3072.	1.181	1.008	0.01002	1817506.	29.530	1.352	27.497	1.634	28.038	72.59	C
3674.	0.361	0.983	0.01002	1817282.	28.495	1.964	27.074	1.939	28.121	72.59	C
4910.	0.886	0.921	0.01002	1816811.	28.474	2.577	26.434	2.550	27.254	72.59	C
6152.	1.540	0.843	0.01002	1816352.	28.452	3.174	25.529	3.148	27.499	72.59	C
6967.	2.011	0.784	0.01002	1815083.	28.415	3.504	24.675	3.530	26.837	72.59	C
8158.	2.817	0.688	0.01002	1814755.	28.393	4.103	23.446	4.078	26.225	72.59	C
9515.	3.851	0.563	0.01002	1814389.	28.366	4.714	21.765	4.688	24.917	72.59	C
10217.	4.431	0.493	0.01002	1814204.	28.352	5.325	19.751	4.997	23.619	72.59	C
10917.	5.040	0.419	0.01002	1814096.	28.338	5.938	17.640	5.301	23.284	72.59	C
12352.	6.375	0.257	0.01002	1813891.	28.311	6.532	15.748	5.913	21.385	72.59	C
1152.	9.119	1.079	0.01014	2202960.	45.525	0.125	35.862	0.712	36.236	72.59	C
2198.	6.084	1.053	0.01014	2202775.	42.256	0.738	3				

4159.	2.541	0.144	0.01946	1856654.	29.194	4.714	25.374	4.688	26.590	72.59	P
3562.	2.409	0.130	0.01946	1856489.	29.189	5.325	25.820	4.997	26.731	72.59	P
3143.	2.307	0.118	0.01946	1856356.	29.184	5.938	26.167	5.301	26.881	72.59	P
2807.	2.180	0.098	0.01946	1856093.	29.176	6.532	26.422	5.913	26.982	72.59	P
30791.	7.536	0.770	0.02279	1995640.	32.110	0.125	11.583	0.712	24.555	72.59	P
24651.	6.444	0.591	0.02279	1994244.	32.054	0.738	15.968	1.325	25.341	72.59	P
21850.	5.941	0.516	0.02279	1993540.	32.028	1.352	19.249	1.634	25.919	72.59	P
19281.	5.480	0.450	0.02279	1993030.	32.008	1.964	21.928	1.939	27.619	72.59	P
14700.	4.646	0.343	0.02279	1992039.	31.973	2.577	23.979	2.550	26.624	72.59	P
10965.	3.948	0.264	0.02279	1991071.	31.942	3.174	25.272	3.148	27.988	72.59	P
8967.	3.540	0.225	0.02279	1989310.	31.901	3.504	26.153	3.530	28.160	72.59	P
6615.	3.078	0.181	0.02279	1988916.	31.887	4.103	27.036	4.078	29.191	72.59	P
4727.	2.677	0.146	0.02279	1988478.	31.874	4.714	27.788	4.688	29.142	72.59	P
4062.	2.519	0.133	0.02279	1988256.	31.867	5.325	28.308	4.997	29.280	72.59	P
3598.	2.394	0.121	0.02279	1988100.	31.862	5.938	28.701	5.301	29.473	72.59	P
3241.	2.232	0.100	0.02279	1987796.	31.853	6.532	28.995	5.913	29.633	72.59	P

APPENDIX C4

Convective condensation of R134a within a micro-fin tube

(file: taraw.tbl)

q'' (W/m ²)	ΔT_f (K)	χ_a	m_f (kg/s)	P_f (Pa)	T_f (°C)	z_f (m)	T_i (°C)	z_w (m)	T_w (°C)	M (g/mole)	flow
373.	1.250	1.014	0.01685	1038738.	42.769	0.125	40.352	0.712	40.776	102.03	C
1176.	0.544	1.007	0.01685	1037505.	41.709	0.738	39.969	1.325	40.482	102.03	C
1749.	-0.162	1.000	0.01685	1036883.	40.744	1.352	39.603	1.634	40.315	102.03	C
2426.	0.121	0.990	0.01685	1036183.	40.719	1.964	39.072	1.939	40.323	102.03	C
4115.	0.848	0.959	0.01685	1034763.	40.667	2.577	38.181	2.550	39.845	102.03	C
6194.	1.763	0.911	0.01685	1033374.	40.617	3.174	37.134	3.148	39.734	102.03	C
7747.	2.196	0.870	0.01685	1025371.	40.326	3.504	36.101	3.530	39.054	102.03	C
10278.	3.322	0.792	0.01685	1023824.	40.270	4.103	33.912	4.078	38.186	102.03	C
13508.	4.774	0.679	0.01685	1022106.	40.207	4.714	30.665	4.688	36.482	102.03	C
15314.	5.591	0.609	0.01685	1021235.	40.175	5.325	26.047	4.997	34.299	102.03	C
17202.	6.461	0.532	0.01685	1020770.	40.158	5.938	20.532	5.301	33.532	102.03	C
21335.	8.375	0.347	0.01685	1019895.	40.126	6.532	15.082	5.913	30.376	102.03	C
632.	2.157	1.022	0.01887	1221001.	49.934	0.125	46.003	0.712	46.932	102.03	C
1657.	1.234	1.012	0.01887	1219748.	48.582	0.738	45.370	1.325	46.546	102.03	C
2342.	0.342	1.003	0.01887	1219116.	47.375	1.352	44.833	1.634	46.304	102.03	C
3127.	0.254	0.991	0.01887	1218369.	46.912	1.964	44.092	1.939	46.337	102.03	C
5035.	1.151	0.955	0.01887	1216847.	46.863	2.577	42.821	2.550	45.681	102.03	C
7326.	2.275	0.901	0.01887	1215361.	46.815	3.174	41.451	3.148	45.585	102.03	C
9014.	2.890	0.856	0.01887	1207126.	46.551	3.504	41.013	3.530	44.855	102.03	C
11736.	4.278	0.773	0.01887	1205612.	46.502	4.103	38.323	4.078	43.644	102.03	C
15179.	6.064	0.654	0.01887	1203930.	46.447	4.714	34.682	4.688	41.534	102.03	C
17092.	7.067	0.581	0.01887	1203078.	46.420	5.325	29.280	4.997	39.071	102.03	C
19085.	8.133	0.501	0.01887	1202692.	46.407	5.938	23.189	5.301	38.121	102.03	C
23429.	10.473	0.311	0.01887	1201986.	46.385	6.532	17.648	5.913	34.264	102.03	C
789.	2.135	1.023	0.01918	1219517.	50.049	0.125	46.226	0.712	46.835	102.03	C
2005.	1.022	1.011	0.01918	1218218.	48.423	0.738	45.640	1.325	46.455	102.03	C
2806.	-0.028	1.001	0.01918	1217563.	46.996	1.352	45.117	1.634	46.206	102.03	C
3719.	0.284	0.987	0.01918	1216772.	46.861	1.964	44.369	1.939	46.228	102.03	C
5922.	1.361	0.945	0.01918	1215158.	46.809	2.577	43.107	2.550	45.153	102.03	C
8551.	2.711	0.883	0.01918	1213580.	46.758	3.174	41.644	3.148	45.466	102.03	C
10481.	3.488	0.831	0.01918	1205067.	46.484	3.504	40.313	3.530	44.452	102.03	C
13586.	5.156	0.736	0.01918	1203541.	46.435	4.103	37.200	4.078	43.007	102.03	C
17503.	7.299	0.601	0.01918	1201845.	46.380	4.714	32.801	4.688	40.496	102.03	C
19677.	8.503	0.518	0.01918	1200986.	46.352	5.325	26.564	4.997	37.753	102.03	C
21939.	9.781	0.427	0.01918	1200674.	46.342	5.938	19.440	5.301	36.373	102.03	C
26863.	12.587	0.213	0.01918	1200130.	46.325	6.532	13.349	5.913	31.672	102.03	C
415.	2.639	1.027	0.02366	1318917.	53.490	0.125	49.343	0.712	50.006	102.03	C
1448.	2.249	1.021	0.02366	1317181.	52.632	0.738	48.678	1.325	49.584	102.03	C
2207.	1.721	1.014	0.02366	1316306.	51.762	1.352	48.144	1.634	49.322	102.03	C
3109.	0.889	1.005	0.02366	1315229.	50.522	1.964	47.404	1.939	49.333	102.03	C
5387.	1.253	0.974	0.02366	1313028.	49.859	2.577	46.147	2.550	48.206	102.03	C
8214.	2.463	0.926	0.02366	1310878.	49.794	3.174	44.723	3.148	48.551	102.03	C
10336.	3.062	0.885	0.02366	1299158.	49.437	3.504	43.758	3.530	47.589	102.03	C
13803.	4.559	0.806	0.02366	1296982.	49.371	4.103	40.837	4.078	46.393	102.03	C
18245.	6.485	0.690	0.02366	1294565.	49.297	4.714	36.559	4.688	44.135	102.03	C
20733.	7.568	0.619	0.02366	1293339.	49.259	5.325	30.310	4.997	41.349	102.03	C
23336.	8.722	0.539	0.02366	1292746.	49.241	5.938	22.789	5.301	40.368	102.03	C
29045.	11.258	0.348	0.02366	1291649.	49.207	6.532	15.364	5.913	36.166	102.03	C
519.	2.937	1.030	0.02381	1282874.	52.796	0.125	48.321	0.712	48.902	102.03	C
1670.	2.428	1.023	0.02381	1281061.	51.781	0.738	47.645	1.325	48.476	102.03	C
2497.	1.804	1.015	0.02381	1280146.	50.786	1.352	47.096	1.634	48.210	102.03	C
3474.	0.851	1.004	0.02381	1279022.	49.391	1.964	46.321	1.939	48.212	102.03	C
5919.	1.322	0.971	0.02381	1276723.	48.748	2.577	45.025	2.550	47.012	102.03	C
8934.	2.634	0.919	0.02381	1274478.	48.679	3.174	43.530	3.148	47.408	102.03	C
11188.	3.284	0.875	0.02381	1262047.	48.292	3.504	42.180	3.530	46.326	102.03	C
14863.	4.908	0.792	0.02381	1259791.	48.222	4.103	38.982	4.078	45.025	102.03	C
19559.	6.998	0.669	0.02381	1257284.	48.143	4.714	34.280	4.688	42.577	102.03	C
22186.	8.173	0.594	0.02381	1256013.	48.104	5.325	27.427	4.997	39.570	102.03	C
24932.	9.425	0.510	0.02381	1255423.	48.085	5.938	19.278	5.301	38.494	102.03	C
30947.	12.177	0.310	0.02381	1254340.	48.051	6.532	11.599	5.913	33.925	102.03	C
2776.	3.977	1.023	0.02135	990435.	42.386	0.125	37.554	0.712	38.440	102.03	C
5089.	0.865	0.993	0.02135	988158.	38.951	0.738	36.834	1.325	37.852	102.03	C
6224.	1.058	0.972	0.02135	987010.	38.908	1.352	36.198	1.634	37.473	102.03	C
7323.	1.289	0.946	0.02135	985684.	38.858	1.964	35.425	1.939	37.657	102.03	C
9466.	1.897	0.884	0.02135	982985.	38.757	2.577	34.343	2.550	36.127	102.03	C
11482.	2.678	0.807	0.02135	980348.	38.658	3.174	33.212	3.148	36.680	102.03	C
12726.	2.850	0.752	0.02135	967480.	38.170	3.504	32.525	3.530	35.732	102.03	C
14462.	3.846	0.661	0.02135	965315.	38.088	4.103	30.850	4.078	34.748	102.03	C
16313.	5.135	0.546	0.02135	962909.	37.996	4.714	28.941	4.688	33.312	102.03	C
17220.	5.861	0.483	0.02135	961689.	37.949	5.325	26.566	4.997	31.541	102.03	C
18092.	6.650	0.418	0.02135	961152.	37.929	5.938	24.003	5.301	31.358	102.03	C
19787.	8.386	0.276	0.02135	960176.	37.891	6.532	21.741	5.913	29.130	102.03	C
2911.	3.575	1.019	0.02122	945809.	40.287	0.125	35.968	0.712	36.739	102.03	C
5324.	0.858	0.989	0.02122	943420.	37.246	0.738	35.299	1.325	36.160	102.03	C
6503.	1.050	0.966	0.02122	942215.	37.199	1.352	34.672	1.634	35.772	102.03	C
7640.	1.279	0.940	0.02122	940820.	37.145	1.964	33.924	1.939	35.963	102.03	C
9851.	1.883	0.875	0.02122	937983.	37.034	2.577	32.879	2.550	34.451	102.03	C
11916.	2.662	0.796	0.02122	935210.	36.926	3.174	31.761	3.148	34.998	102.03	C
13184.	2.799	0.739	0.02122	921750.	36.398	3.504	30.837	3.530	33.956	102.03	C
14942.	3.796	0.645	0.02122	919486.	36.308	4.103	29.179	4.078	33.000	102.03	C
16803.	5.088	0.528	0.02122	916971.	36.209	4.714	27.242	4.688	31.539	102.03	C
17710.	5.817	0.464	0.02122	915696.	36.158	5.325	24.915	4.997	29.785	102.03	C
18577.	6.610	0.397	0.02122	915136.	36.136	5.938	22.362	5.301	29.596	102.03	C
20249.	8.358	0.252	0.02122	914116.	36.095	6.532	20.105	5.913	27.407	102.03	C
2913.	6.692	1.047	0.02856	1290112.	55.245	0.125	47.832	0.712	48.611	102.03	C
5493.	3.708	1.022	0.02856	1287336.	51.884	0.738	47.011	1.325	47.890	102.03	C
6817.	1.550	1.003	0.02856	1285938.	49.450	1.352	46.312	1.634	47.464	102.03	C
8136.	1.403	0.981	0.02856	1284098.	48.976	1.964	45.469	1.939	47.611	102.03	C
10829.	2.114	0.924	0.02856	1280321.	48.859	2.577	44.285	2.550	45.955	102.03	C
13518.	3.026	0.853	0.02856	1276631.	48.745	3.174	43.017	3.148	46.567	102.03	C
15268.	3.298	0.800	0.02856	1260599.	48.247	3.504	42.019	3.530	45.371	102.03	C
17820.	4.467	0.712	0.02856	1257739.	48.158	4.103	39.983	4.078	44.287	102.03	C
20712.	5.978	0.597	0.02856	1254561.	48.058	4.714	37.567	4.688	42.547	102.03	C
22201.	6.830	0.533	0.02856	1252950.	48.008	5.325	34.523	4.997	40.590	102.03	C
23681.	7.747	0.465	0.02856	1252113.	47.						

113.	4.950	1.036	0.00734	1027047.	45.698	0.125	40.152	0.712	40.402	102.03	C
433.	4.277	1.031	0.00734	1026800.	44.855	0.738	39.844	1.325	40.233	102.03	C
673.	3.497	1.024	0.00734	1026675.	43.949	1.352	39.714	1.634	40.166	102.03	C
960.	2.330	1.016	0.00734	1026511.	42.634	1.964	39.522	1.939	40.157	102.03	C
1690.	0.426	0.987	0.00734	1026172.	40.356	2.577	39.183	2.550	39.809	102.03	C
2600.	0.878	0.941	0.00734	1025841.	40.343	3.174	38.680	3.148	39.905	102.03	C
3286.	1.199	0.900	0.00734	1025108.	40.317	3.504	38.248	3.530	39.628	102.03	C
4409.	1.758	0.824	0.00734	1024811.	40.306	4.103	37.235	4.078	39.201	102.03	C
5849.	2.474	0.712	0.00734	1024481.	40.294	4.714	35.820	4.688	38.330	102.03	C
6657.	2.876	0.642	0.00734	1024313.	40.288	5.325	33.713	4.997	37.370	102.03	C
7503.	3.299	0.564	0.00734	1024186.	40.283	5.938	31.230	5.301	36.970	102.03	C
9360.	4.226	0.379	0.00734	1023937.	40.274	6.532	28.621	5.913	35.233	102.03	C
140.	5.092	1.037	0.00689	1015681.	45.425	0.125	39.749	0.712	39.995	102.03	C
471.	4.247	1.030	0.00689	1015506.	44.410	0.738	39.448	1.325	39.829	102.03	C
712.	3.339	1.023	0.00689	1015419.	43.376	1.352	39.313	1.634	39.753	102.03	C
997.	2.020	1.013	0.00689	1015282.	41.909	1.964	39.116	1.939	39.739	102.03	C
1714.	0.433	0.982	0.00689	1015000.	39.947	2.577	38.771	2.550	39.396	102.03	C
2602.	0.888	0.933	0.00689	1014724.	39.937	3.174	38.257	3.148	39.483	102.03	C
3267.	1.220	0.890	0.00689	1014248.	39.919	3.504	37.815	3.530	39.191	102.03	C
4351.	1.781	0.810	0.00689	1014009.	39.910	4.103	36.807	4.078	38.776	102.03	C
5739.	2.502	0.693	0.00689	1013742.	39.901	4.714	35.398	4.688	37.901	102.03	C
6516.	2.906	0.620	0.00689	1013607.	39.896	5.325	33.328	4.997	36.971	102.03	C
7328.	3.330	0.539	0.00689	1013520.	39.893	5.938	30.891	5.301	36.541	102.03	C
9108.	4.262	0.347	0.00689	1013350.	39.886	6.532	28.369	5.913	34.815	102.03	C
4132.	5.375	1.031	0.02666	1042554.	45.414	0.125	39.248	0.712	40.111	102.03	C
7477.	1.202	0.995	0.02666	1039257.	40.830	0.738	38.431	1.325	39.401	102.03	C
9081.	1.443	0.970	0.02666	1037595.	40.770	1.352	37.660	1.634	38.892	102.03	C
10610.	1.726	0.940	0.02666	1035530.	40.695	1.964	36.740	1.939	39.142	102.03	C
13520.	2.477	0.867	0.02666	1031310.	40.542	2.577	35.452	2.550	37.258	102.03	C
16159.	3.449	0.780	0.02666	1027185.	40.392	3.174	33.841	3.148	37.667	102.03	C
17747.	3.650	0.717	0.02666	1009719.	39.753	3.504	32.597	3.530	36.457	102.03	C
19872.	4.918	0.616	0.02666	1006810.	39.645	4.103	30.529	4.078	35.262	102.03	C
22032.	6.558	0.490	0.02666	1003578.	39.526	4.714	28.129	4.688	33.413	102.03	C
23047.	7.483	0.422	0.02666	1001940.	39.465	5.325	25.217	4.997	31.396	102.03	C
23992.	8.487	0.351	0.02666	1001205.	39.438	5.938	22.168	5.301	31.083	102.03	C
25736.	10.697	0.201	0.02666	999865.	39.388	6.532	19.533	5.913	28.313	102.03	C
4015.	4.608	1.025	0.02791	991962.	42.758	0.125	37.362	0.712	38.259	102.03	C
7297.	1.198	0.992	0.02791	988179.	38.952	0.738	36.548	1.325	37.569	102.03	C
8884.	1.417	0.969	0.02791	986271.	38.880	1.352	35.778	1.634	37.056	102.03	C
10404.	1.674	0.942	0.02791	983895.	38.791	1.964	34.863	1.939	37.323	102.03	C
13324.	2.364	0.874	0.02791	979035.	38.608	2.577	33.588	2.550	35.421	102.03	C
16007.	3.266	0.792	0.02791	974287.	38.429	3.174	31.986	3.148	35.884	102.03	C
17641.	3.296	0.735	0.02791	953783.	37.646	3.504	30.758	3.530	34.619	102.03	C
19857.	4.489	0.639	0.02791	950308.	37.512	4.103	28.728	4.078	33.517	102.03	C
22152.	6.038	0.521	0.02791	946448.	37.363	4.714	26.332	4.688	31.710	102.03	C
23249.	6.914	0.456	0.02791	944490.	37.287	5.325	23.441	4.997	29.708	102.03	C
24284.	7.874	0.389	0.02791	943582.	37.252	5.938	20.319	5.301	29.535	102.03	C
26235.	9.991	0.245	0.02791	941914.	37.187	6.532	17.536	5.913	26.938	102.03	C
4322.	5.046	1.031	0.02797	1208013.	50.780	0.125	44.807	0.712	45.733	102.03	C
7819.	1.191	0.995	0.02797	1204966.	46.481	0.738	43.923	1.325	45.021	102.03	C
9497.	1.466	0.968	0.02797	1203430.	46.431	1.352	43.133	1.634	44.493	102.03	C
11094.	1.791	0.938	0.02797	1201525.	46.370	1.964	42.167	1.939	44.757	102.03	C
14136.	2.641	0.862	0.02797	1197632.	46.244	2.577	40.822	2.550	42.788	102.03	C
16894.	3.728	0.771	0.02797	1193828.	46.120	3.174	39.169	3.148	43.147	102.03	C
18553.	4.125	0.706	0.02797	1178191.	45.609	3.504	37.932	3.530	41.908	102.03	C
20772.	5.527	0.600	0.02797	1175714.	45.528	4.103	35.751	4.078	40.564	102.03	C
23029.	7.336	0.470	0.02797	1172962.	45.437	4.714	33.206	4.688	38.749	102.03	C
24089.	8.354	0.399	0.02797	1171567.	45.391	5.325	30.135	4.997	36.412	102.03	C
25076.	9.448	0.325	0.02797	1171010.	45.373	5.938	26.958	5.301	36.054	102.03	C
26896.	11.855	0.170	0.02797	1170015.	45.340	6.532	24.321	5.913	32.969	102.03	C
3487.	4.279	1.028	0.02829	1313358.	53.427	0.125	48.409	0.712	49.179	102.03	C
6421.	1.020	0.998	0.02829	1310553.	49.784	0.738	47.633	1.325	48.526	102.03	C
7871.	1.259	0.976	0.02829	1309140.	49.741	1.352	46.954	1.634	48.067	102.03	C
9280.	1.540	0.950	0.02829	1307383.	49.688	1.964	46.121	1.939	48.269	102.03	C
12051.	2.276	0.885	0.02829	1303790.	49.578	2.577	44.957	2.550	46.625	102.03	C
14684.	3.217	0.805	0.02829	1300280.	49.471	3.174	43.532	3.148	46.915	102.03	C
16336.	3.543	0.747	0.02829	1285270.	49.012	3.504	42.467	3.530	45.831	102.03	C
18644.	4.750	0.652	0.02829	1282756.	48.934	4.103	40.510	4.078	44.682	102.03	C
21136.	6.309	0.532	0.02829	1279964.	48.848	4.714	38.249	4.688	43.008	102.03	C
22370.	7.186	0.466	0.02829	1278548.	48.804	5.325	35.401	4.997	41.106	102.03	C
23565.	8.129	0.396	0.02829	1277868.	48.783	5.938	32.340	5.301	40.795	102.03	C
25913.	10.203	0.246	0.02829	1276610.	48.744	6.532	29.594	5.913	38.102	102.03	C
2999.	7.067	1.051	0.02389	1304709.	56.088	0.125	48.279	0.712	49.102	102.03	C
5511.	3.373	1.020	0.02389	1302751.	52.052	0.738	47.512	1.325	48.465	102.03	C
6747.	1.087	0.997	0.02389	1301764.	49.517	1.352	46.900	1.634	48.049	102.03	C
7946.	1.345	0.971	0.02389	1300436.	49.476	1.964	46.163	1.939	48.199	102.03	C
10293.	2.014	0.905	0.02389	1297706.	49.393	2.577	45.146	2.550	46.767	102.03	C
12511.	2.865	0.825	0.02389	1295038.	49.311	3.174	43.921	3.148	47.032	102.03	C
13897.	3.233	0.766	0.02389	1284218.	48.979	3.504	43.074	3.530	46.100	102.03	C
15823.	4.318	0.670	0.02389	1282296.	48.920	4.103	41.355	4.078	45.027	102.03	C
17888.	5.716	0.549	0.02389	1280160.	48.854	4.714	39.403	4.688	43.601	102.03	C
18906.	6.503	0.483	0.02389	1279078.	48.821	5.325	36.934	4.997	41.806	102.03	C
19887.	7.344	0.413	0.02389	1278544.	48.804	5.938	34.316	5.301	41.552	102.03	C
21804.	9.195	0.263	0.02389	1277552.	48.774	6.532	31.953	5.913	39.230	102.03	C
3261.	6.740	1.044	0.02347	1139352.	50.415	0.125	43.037	0.712	43.751	102.03	C
5952.	2.470	1.011	0.02347	1137089.	45.794	0.738	42.319	1.325	43.113	102.03	C
7263.	1.137	0.988	0.02347	1135949.	44.203	1.352	41.682	1.634	42.685	102.03	C
8524.	1.393	0.960	0.02347	1134476.	44.153	1.964	40.932	1.939	42.856	102.03	C
10965.	2.064	0.891	0.02347	1131457.	44.051	2.577	39.885	2.550	41.333	102.03	C
13233.	2.923	0.808	0.02347	1128507.	43.951	3.174	38.576	3.148	41.646	102.03	C
14629.	3.222	0.747	0.02347	1116187.	43.531	3.504	37.564	3.530	40.651	102.03	C
16541.	4.321	0.649	0.02347	1113969.	43.456	4.103	35.824	4.078	39.575	102.03	C
18550.	5.741	0.526	0.02347	1111504.	43.371	4.714	33.794	4.688	38.084	102.03	C
19523.	6.541	0.459	0.02347	1110255.	43.328	5.325	31.345	4.997	36.237	102.03	C
20450.	7.402	0.389	0.02347	1109661.	43.308	5.938	28.700	5.301	35.998	102.03	C
22225.	9.296	0.239	0.02347	1108565.	43.270	6.532	26.315	5.913	33.650	102.03	C
3097.	4.602	1.027	0.02218	1042914.	44.932	0.125	39.671	0.712	40.387	102.03	C

1968.	1.626	0.134	0.01338	1202380.	46.397	4.714	43.848	4.688	44.793	102.03	P	37990.	8.435	0.779	0.02841	1152326.	44.753	0.125	20.305	0.712	36.412	102.03	P
1698.	1.527	0.122	0.01338	1202318.	46.395	5.325	44.042	4.997	44.879	102.03	P	29669.	7.224	0.580	0.02841	1149232.	44.649	0.738	26.069	1.325	37.010	102.03	P
1556.	1.450	0.112	0.01338	1202246.	46.393	5.938	44.260	5.301	44.913	102.03	P	25912.	6.657	0.498	0.02841	1147672.	44.597	1.352	30.247	1.634	37.694	102.03	P
1646.	1.358	0.092	0.01338	1202098.	46.388	6.532	44.476	5.913	44.982	102.03	P	22495.	6.147	0.428	0.02841	1146720.	44.565	1.964	33.414	1.939	39.619	102.03	P
13531.	4.140	0.766	0.00993	1191943.	46.059	0.125	34.534	0.712	42.171	102.03	P	16493.	5.209	0.315	0.02841	1144911.	44.504	2.577	35.774	2.550	38.612	102.03	P
10534.	3.478	0.562	0.00993	1191639.	46.049	0.738	37.268	1.325	42.259	102.03	P	11734.	4.403	0.235	0.02841	1143143.	44.445	3.174	37.271	3.148	39.881	102.03	P
9173.	3.182	0.478	0.00993	1191486.	46.044	1.352	39.257	1.634	42.630	102.03	P	9268.	3.835	0.197	0.02841	1138798.	44.299	3.504	38.271	3.530	40.355	102.03	P
7929.	2.915	0.406	0.00993	1191359.	46.040	1.964	40.659	1.939	43.526	102.03	P	6506.	3.284	0.156	0.02841	1138071.	44.274	4.103	39.166	4.078	41.381	102.03	P
5723.	2.453	0.291	0.00993	1191111.	46.032	2.577	41.753	2.550	43.263	102.03	P	4516.	2.778	0.125	0.02841	1137263.	44.247	4.714	40.010	4.688	41.457	102.03	P
3944.	2.095	0.211	0.00993	1190868.	46.024	3.174	42.437	3.148	43.975	102.03	P	3942.	2.565	0.112	0.02841	1136854.	44.233	5.325	40.541	4.997	41.673	102.03	P
3004.	1.932	0.174	0.00993	1191254.	46.036	3.504	42.967	3.530	44.076	102.03	P	3663.	2.387	0.101	0.02841	1136536.	44.223	5.938	40.969	5.301	41.817	102.03	P
1919.	1.746	0.137	0.00993	1191225.	46.035	4.103	43.284	4.078	44.609	102.03	P	3959.	2.112	0.080	0.02841	1135910.	44.202	6.532	41.338	5.913	42.043	102.03	P
1082.	1.632	0.112	0.00993	1191192.	46.034	4.714	43.663	4.688	44.395	102.03	P	38870.	8.344	0.768	0.02809	1006642.	39.639	0.125	14.857	0.712	31.349	102.03	P
805.	1.610	0.104	0.00993	1191176.	46.034	5.325	43.685	4.997	44.379	102.03	P	30403.	7.185	0.570	0.02809	1003120.	39.509	0.738	20.631	1.325	31.955	102.03	P
631.	1.612	0.098	0.00993	1191098.	46.031	5.938	43.764	5.301	44.383	102.03	P	26576.	6.640	0.488	0.02809	1001345.	39.443	1.352	24.841	1.634	32.576	102.03	P
572.	1.688	0.088	0.00993	1190933.	46.026	6.532	43.877	5.913	44.293	102.03	P	23095.	6.153	0.417	0.02809	1000276.	39.403	1.964	28.082	1.939	34.498	102.03	P
11786.	3.475	0.751	0.00971	1142013.	44.407	0.125	34.490	0.712	41.111	102.03	P	16971.	5.258	0.304	0.02809	998250.	39.328	2.577	30.473	2.550	33.305	102.03	P
9185.	2.950	0.572	0.00971	1141638.	44.394	0.738	36.854	1.325	41.180	102.03	P	12105.	4.483	0.223	0.02809	996270.	39.254	3.174	31.974	3.148	34.613	102.03	P
8012.	2.706	0.497	0.00971	1141449.	44.388	1.352	38.577	1.634	41.517	102.03	P	9578.	3.908	0.186	0.02809	991513.	39.077	3.504	32.950	3.530	35.025	102.03	P
6947.	2.480	0.434	0.00971	1141310.	44.383	1.964	39.812	1.939	42.285	102.03	P	6733.	3.380	0.144	0.02809	990756.	39.048	4.103	33.901	4.078	36.093	102.03	P
5079.	2.065	0.331	0.00971	1141040.	44.374	2.577	40.778	2.550	42.062	102.03	P	4664.	2.890	0.113	0.02809	989914.	39.017	4.714	34.722	4.688	36.131	102.03	P
3605.	1.711	0.259	0.00971	1140775.	44.366	3.174	41.382	3.148	42.664	102.03	P	4054.	2.681	0.100	0.02809	989487.	39.001	5.325	35.312	4.997	36.329	102.03	P
2846.	1.525	0.224	0.00971	1141018.	44.374	3.504	41.847	3.530	42.800	102.03	P	3743.	2.505	0.089	0.02809	989178.	38.989	5.938	35.728	5.301	36.461	102.03	P
2002.	1.278	0.187	0.00971	1140941.	44.371	4.103	42.152	4.078	43.314	102.03	P	3983.	2.228	0.068	0.02809	988573.	38.967	6.532	36.064	5.913	36.686	102.03	P
1405.	1.055	0.158	0.00971	1140855.	44.368	4.714	42.554	4.688	43.313	102.03	P	25929.	6.284	0.769	0.01959	1035781.	40.704	0.125	23.490	0.712	34.579	102.03	P
1241.	0.961	0.147	0.00971	1140811.	44.367	5.325	42.704	4.997	43.404	102.03	P	20416.	5.433	0.578	0.01959	1034025.	40.641	0.738	27.364	1.325	34.891	102.03	P
1169.	0.881	0.137	0.00971	1140739.	44.364	5.938	42.888	5.301	43.471	102.03	P	17921.	5.033	0.498	0.01959	1033141.	40.609	1.352	30.185	1.634	35.305	102.03	P
1297.	0.760	0.116	0.00971	1140588.	44.359	6.532	43.097	5.913	43.547	102.03	P	15647.	4.669	0.429	0.01959	1032561.	40.588	1.964	32.275	1.939	36.696	102.03	P
22997.	6.428	0.768	0.01605	1041801.	40.921	0.125	23.410	0.712	34.655	102.03	P	11637.	4.000	0.316	0.01959	1031449.	40.547	2.577	33.904	2.550	36.066	102.03	P
18023.	5.427	0.561	0.01605	1040656.	40.880	0.738	27.493	1.325	35.176	102.03	P	8437.	3.420	0.236	0.01959	1030362.	40.508	3.174	34.960	3.148	37.061	102.03	P
15758.	4.975	0.474	0.01605	1040078.	40.859	1.352	30.402	1.634	35.631	102.03	P	6768.	3.045	0.196	0.01959	1028468.	40.439	3.504	35.725	3.530	37.321	102.03	P
13685.	4.572	0.400	0.01605	1039740.	40.847	1.964	32.527	1.939	37.001	102.03	P	4871.	2.644	0.154	0.01959	1028066.	40.424	4.103	36.342	4.078	38.132	102.03	P
10000.	3.870	0.281	0.01605	1039101.	40.824	2.577	34.195	2.550	36.480	102.03	P	3465.	2.273	0.120	0.01959	1027620.	40.408	4.714	36.975	4.688	38.104	102.03	P
7015.	3.317	0.198	0.01605	1038476.	40.802	3.174	35.235	3.148	37.392	102.03	P	3033.	2.114	0.106	0.01959	1027394.	40.400	5.325	37.314	4.997	38.243	102.03	P
5427.	3.027	0.158	0.01605	1037921.	40.782	3.504	36.007	3.530	37.612	102.03	P	2794.	1.980	0.095	0.01959	1027241.	40.394	5.938	37.652	5.301	38.401	102.03	P
3580.	2.727	0.118	0.01605	1037698.	40.773	4.103	36.553	4.078	38.488	102.03	P	2870.	1.768	0.072	0.01959	1026946.	40.384	6.532	37.933	5.913	38.584	102.03	P
2128.	2.524	0.089	0.01605	1037451.	40.765	4.714	37.136	4.688	38.288	102.03	P	27802.	6.617	0.772	0.01976	938041.	37.037	0.125	18.901	0.712	30.567	102.03	P
1633.	2.474	0.080	0.01605	1037326.	40.760	5.325	37.262	4.997	38.268	102.03	P	21862.	5.732	0.573	0.01976	936046.	36.959	0.738	23.030	1.325	30.920	102.03	P
1305.	2.462	0.073	0.01605	1037267.	40.758	5.938	37.406	5.301	38.249	102.03	P	19172.	5.317	0.490	0.01976	935040.	36.920	1.352	25.978	1.634	31.352	102.03	P
1122.	2.542	0.061	0.01605	1037159.	40.754	6.532	37.532	5.913	38.141	102.03	P	16720.	4.943	0.418	0.01976	934411.	36.895	1.964	28.254	1.939	32.796	102.03	P
17557.	4.768	0.765	0.01418	1101401.	43.023	0.125	31.006	0.712	38.380	102.03	P	12392.	4.256	0.303	0.01976	933211.	36.848	2.577	29.968	2.550	32.033	102.03	P
13840.	4.092	0.582	0.01418	1100530.	42.993	0.738	33.689	1.325	38.683	102.03	P	8932.	3.665	0.220	0.01976	932038.	36.802	3.174	31.055	3.148	33.043	102.03	P
12158.	3.777	0.506	0.01418	1100090.	42.978	1.352	35.611	1.634	38.989	102.03	P	7123.	3.280	0.179	0.01976	930060.	36.725	3.504	31.798	3.530	33.363	102.03	P
10628.	3.488	0.440	0.01418	1099774.	42.967	1.964	37.041	1.939	39.989	102.03	P	5063.	2.879	0.136	0.01976	929651.	36.709	4.103	32.496	4.078	34.207	102.03	P
7933.	2.958	0.333	0.01418	1099159.	42.946	2.577	38.189	2.550	39.687	102.03	P	3525.	2.512	0.102	0.01976	929195.	36.691	4.714	33.100	4.688	34.157	102.03	P
5789.	2.506	0.256	0.01418	1098559.	42.925	3.174	38.932	3.148	40.456	102.03	P	3048.	2.357	0.089	0.01976	928964.	36.682	5.325	33.523	4.997	34.345	102.03	P
4676.	2.242	0.217	0.01418	1097932.	42.903	3.504	39.469	3.530	40.577	102.03	P	2776.	2.229	0.078	0.01976	928833.	36.676	5.938	33.823	5.301	34.471	102.03	P
3417.	1.935	0.175	0.01418	1097728.	42.896	4.103	39.883	4.078	41.166	102.03	P	2826.	2.034	0.056	0.01976	928584.	36.667	6.532	34.046	5.913	34.534	102.03	P
2494.	1.656	0.141	0.01418	1097500.	42.888	4.714	40.344	4.688	41.209	102.03	P	22647.	5.908	0.768	0.01974	1216992.	46.868	0.125	31.436	0.712	41.065	102.03	P
2219.	1.541	0.128	0.01418	1097385.	42.884	5.325	40.598	4.997	41.347	102.03	P	17839.	5.041	0.595	0.01974	1215461.	46.819	0.7					

6102.	2.345	0.300	0.00985	933666.	36.866	2.577	32.857	2.550	34.159	102.03	P
4341.	1.984	0.219	0.00985	933361.	36.854	3.174	33.492	3.148	34.916	102.03	P
3412.	1.806	0.179	0.00985	933536.	36.861	3.504	33.973	3.530	34.959	102.03	P
2340.	1.593	0.138	0.00985	933497.	36.859	4.103	34.361	4.078	35.599	102.03	P
1516.	1.430	0.107	0.00985	933454.	36.857	4.714	34.746	4.688	35.470	102.03	P
1246.	1.377	0.096	0.00985	933432.	36.857	5.325	34.906	4.997	35.460	102.03	P
1078.	1.342	0.087	0.00985	933345.	36.853	5.938	35.036	5.301	35.460	102.03	P
1030.	1.329	0.070	0.00985	933159.	36.846	6.532	35.133	5.913	35.457	102.03	P
12593.	3.555	0.759	0.00976	1030591.	40.516	0.125	30.715	0.712	37.163	102.03	P
9852.	3.025	0.573	0.00976	1030204.	40.502	0.738	33.054	1.325	37.198	102.03	P
8615.	2.779	0.496	0.00976	1030009.	40.495	1.352	34.715	1.634	37.540	102.03	P
7489.	2.550	0.429	0.00976	1029842.	40.489	1.964	35.959	1.939	38.337	102.03	P
5513.	2.133	0.322	0.00976	1029511.	40.477	2.577	36.920	2.550	38.061	102.03	P
3947.	1.777	0.246	0.00976	1029188.	40.465	3.174	37.515	3.148	38.708	102.03	P
3138.	1.591	0.208	0.00976	1029381.	40.472	3.504	37.949	3.530	38.797	102.03	P
2231.	1.349	0.168	0.00976	1029300.	40.469	4.103	38.299	4.078	39.376	102.03	P
1580.	1.131	0.137	0.00976	1029211.	40.466	4.714	38.675	4.688	39.323	102.03	P
1393.	1.041	0.125	0.00976	1029166.	40.464	5.325	38.878	4.997	39.510	102.03	P
1303.	0.965	0.114	0.00976	1029095.	40.462	5.938	39.057	5.301	39.448	102.03	P
1407.	0.852	0.092	0.00976	1028950.	40.457	6.532	39.231	5.913	39.526	102.03	P
12474.	3.730	0.792	0.01002	1321063.	50.101	0.125	39.878	0.712	46.576	102.03	P
9728.	3.175	0.600	0.01002	1320770.	50.093	0.738	42.255	1.325	46.634	102.03	P
8489.	2.918	0.520	0.01002	1320623.	50.088	1.352	44.012	1.634	46.981	102.03	P
7362.	2.680	0.452	0.01002	1320479.	50.084	1.964	45.247	1.939	47.774	102.03	P
5385.	2.248	0.342	0.01002	1320190.	50.075	2.577	46.222	2.550	47.593	102.03	P
3820.	1.886	0.265	0.01002	1319908.	50.067	3.174	46.848	3.148	48.238	102.03	P
3012.	1.696	0.227	0.01002	1320124.	50.073	3.504	47.320	3.530	48.285	102.03	P
2108.	1.454	0.187	0.01002	1320060.	50.071	4.103	47.618	4.078	48.850	102.03	P
1461.	1.244	0.157	0.01002	1319989.	50.069	4.714	48.041	4.688	48.837	102.03	P
1278.	1.160	0.145	0.01002	1319953.	50.068	5.325	48.153	4.997	48.902	102.03	P
1192.	1.093	0.135	0.01002	1319895.	50.066	5.938	48.336	5.301	48.953	102.03	P
1304.	1.002	0.114	0.01002	1319775.	50.063	6.532	48.554	5.913	49.008	102.03	P
21402.	6.076	0.782	0.01633	1235476.	47.457	0.125	30.855	0.712	41.454	102.03	P
16601.	5.087	0.584	0.01633	1234481.	47.425	0.738	34.941	1.325	42.059	102.03	P
14438.	4.633	0.502	0.01633	1233979.	47.409	1.352	37.825	1.634	42.586	102.03	P
12475.	4.218	0.432	0.01633	1233628.	47.398	1.964	39.934	1.939	43.898	102.03	P
9038.	3.473	0.321	0.01633	1232949.	47.377	2.577	41.563	2.550	43.528	102.03	P
6331.	2.855	0.244	0.01633	1232286.	47.356	3.174	42.573	3.148	44.563	102.03	P
4940.	2.509	0.207	0.01633	1231604.	47.334	3.504	43.287	3.530	44.688	102.03	P
3401.	2.116	0.168	0.01633	1231379.	47.327	4.103	43.833	4.078	45.432	102.03	P
2327.	1.787	0.139	0.01633	1231129.	47.319	4.714	44.416	4.688	45.454	102.03	P
2038.	1.664	0.128	0.01633	1231003.	47.315	5.325	44.709	4.997	45.627	102.03	P
1922.	1.572	0.118	0.01633	1230918.	47.312	5.938	45.000	5.301	45.728	102.03	P
2194.	1.475	0.097	0.01633	1230754.	47.307	6.532	45.281	5.913	45.854	102.03	P
21433.	6.081	0.781	0.01632	1233976.	47.409	0.125	30.800	0.712	41.408	102.03	P
16624.	5.095	0.583	0.01632	1232982.	47.378	0.738	34.889	1.325	41.999	102.03	P
14458.	4.641	0.502	0.01632	1232480.	47.362	1.352	37.775	1.634	42.536	102.03	P
12492.	4.227	0.432	0.01632	1232134.	47.351	1.964	39.889	1.939	43.831	102.03	P
9050.	3.482	0.320	0.01632	1231464.	47.330	2.577	41.520	2.550	43.472	102.03	P
6339.	2.864	0.243	0.01632	1230809.	47.309	3.174	42.532	3.148	44.506	102.03	P
4946.	2.515	0.206	0.01632	1230059.	47.285	3.504	43.242	3.530	44.633	102.03	P
3404.	2.120	0.167	0.01632	1229829.	47.278	4.103	43.792	4.078	45.369	102.03	P
2329.	1.788	0.138	0.01632	1229574.	47.270	4.714	44.370	4.688	45.403	102.03	P
2040.	1.663	0.127	0.01632	1229444.	47.265	5.325	44.669	4.997	45.592	102.03	P
1924.	1.568	0.116	0.01632	1229330.	47.262	5.938	44.960	5.301	45.700	102.03	P
2197.	1.464	0.096	0.01632	1229101.	47.255	6.532	45.239	5.913	45.793	102.03	P

